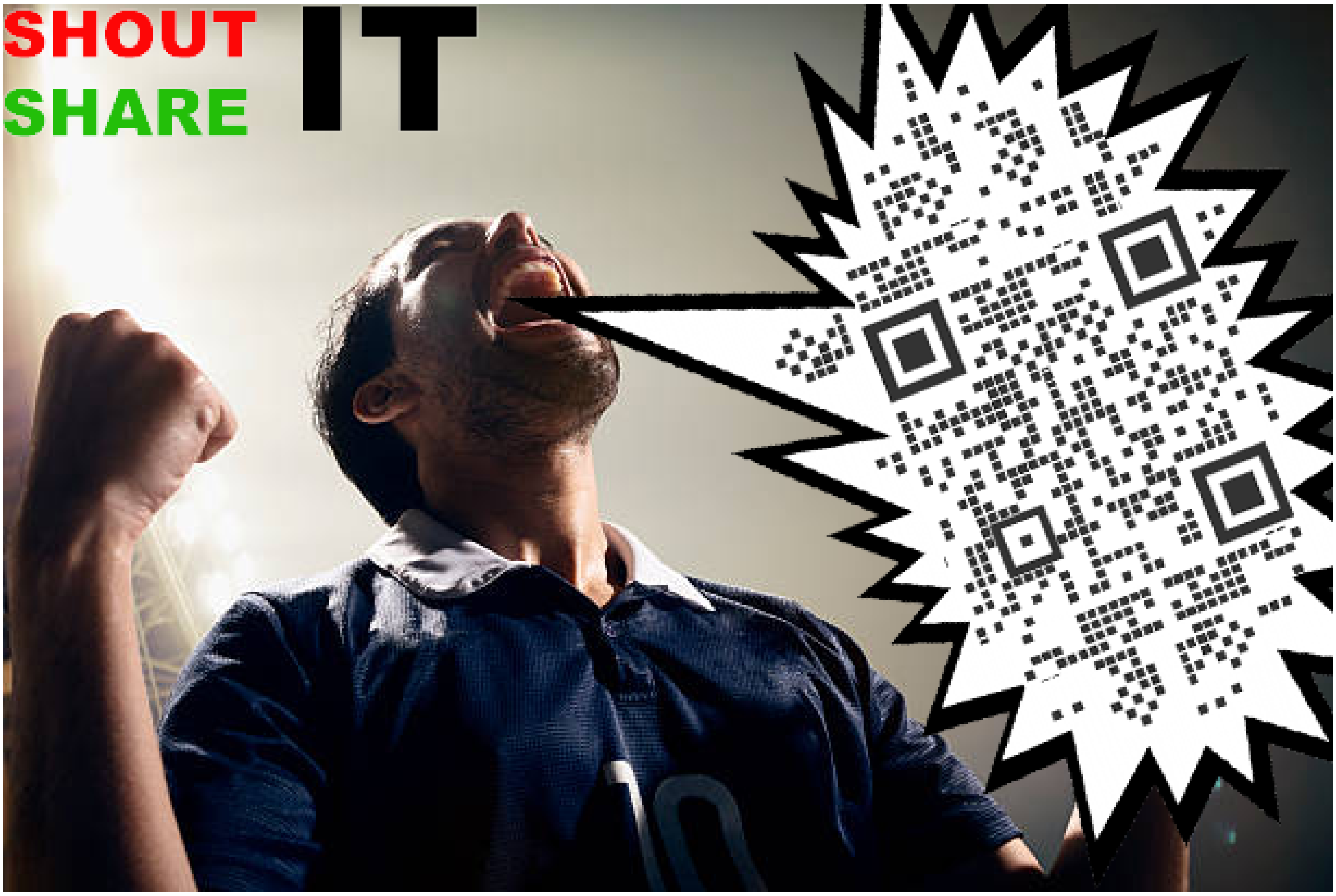
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REPORT

OF THE

Commissioners of Fisheries

OF THE

STATE OF CALIFORNIA,

FOR

THE YEARS 1870 AND 1871.

ins 2945

T. A. SPRINGER.........STATE PRINTER.

REPORT.

To His Excellency, H. H. Haight, Governor of California:

The Commissioners of Fisheries for the State of California, appointed under an Act of the Legislature, entitled "An Act to provide for the restoration and preservation of fish in the waters of this State," approved April second, eighteen hundred and seventy, respectfully submit their first biennial report.

REPORT.

California has a seacoast extending through ten degrees of latitude, and a shore line of nearly eight hundred miles. The Coast Range of mountains, which adjoins the coast line for the greater part of this distance, creates by its western watershed nearly one hundred streams and rivers emptying into the Pacific Ocean. These streams and rivers vary from twenty to sixty miles in length. .The drainage of the western slope of the Sierra Nevada, through seven degrees of latitude, forms several hundred streams, whose united waters make the Sacramento and San Joaquin Rivers—the first navigable for a distance of one hundred and eighty miles, and the last navigable one hundred miles from the ocean. The waters from the eastern slope of the Sierra Nevada flow into brackish and salt lakes, in the State of Nevada, having no outlet into the ocean. Pyramid, the largest of these lakes, receiving the waters of the Truckee River, is forty miles long and twenty miles wide. The inland bays and fresh water lakes of California cover more than six hundred and fifty square miles—an area half as large as the State of Rhode Island.

These few statistics are given that it may be clearly understood how extensive is the field over which, under the law, the Board is expected to prevent the wanton destruction of fish and required to compel the owners of dams to permit the free passage of fish to their native spawning beds. When it is further understood that the members of the Board neither receive nor expect compensation for their services other than the satisfaction of doing something towards the preservation of the fish now in our waters and adding to the food supply of the people by the introduction of new varieties, it will be acknowledged that if but a beginning has been made in this work, at least public attention has been called to the importance of the subject. If a few men of intelligence, living on the banks of each bay, river, and lake, will inform themselves of what has been done in other States and countries for the propagation and preservation of fish, they will create a public opinion that will cause the enactment of proper laws and compel their enforcement. The result will be that after a few years our river fisheries will be largely increased, giving employment to a large number of men, and furnishing a cheap supply of nutritious food to many more people.

FISH WAYS.

The most important means for the preservation of the fish now in our rivers, is in the construction of fish ladders over all dams otherwise impassable. Even traps, seines, and spears will not utterly destroy the fish if some few are permitted to reach their natural spawning beds. It is the instinct of all anadromous fish, after leaving the ocean, to seek the particular stream or rivulet in which they were hatched to deposit their eggs. To reach the particular spot and the parent bed of gravel they will make every effort. Where impassable dams have been placed across streams, the fish will come year after year and leap by the hour to scale the falls until utterly exhausted. If no means are provided by which the fish can pass the dam, in three or four years the stream above the dam will be without fish. A fish ladder is ordinarily so simple and inexpensive an affair that it would seem that men owning dams would, if informed, construct them without the requirements of a compulsory statute. A good fish ladder for use on our mountain streams is made in the form of a long box of plank, open at both ends, four feet wide and three feet high. One end of the box is fastened at the top of the dam, the other end is extended to and fastened in the center of the pool below the dam. In the inside of the box and fastened on its bottom are pieces of plank about four feet apart, placed transversely, and called "riffles." Each riffle is about a foot high. These riffles do not extend from side to side of the box, but only about two thirds across. To illustrate: if the first riffle is fastened on the right side of the box at a right angle to its side, it will extend thirty inches across the box; the next, four feet above, will be fastened on the left side of the box and extend thirty inches across it; and so on, alternately, until the top is reached. The water passing into the top of this box, is caught by these riffles and diverted right and left by them until it reaches the stream below. The fish coming up the stream to the dam seek and explore every crevice and opening where water is passing. If the lower end of the fish way is placed near the centre of the pool below the dam, they readily find it, and immediately enter it. Even if the ladder is placed at so great an angle as forty-five degrees, the fish have no difficulty in passing through it; they will jump through almost any current a distance of four feet, and each riffle gives them a resting place behind which they recover for the next jump. At one dam on a tributary of the Truckee a mill owner consented to put in a fish way, at the earnest solicitation of one of the Commissioners, and to prevent the expenses of a suit. He said the law was an infringement of his rights, and when the Legislature passed an Act to compel him to spend money in such foolish business they should have appointed a schoolmaster to teach the trout how to use the contrivance; he did not believe a fish could be coaxed to go near it. The next evening after the fish way was placed in position the fish were passing it every few minutes; the mill owner became a convert to the practical use of fish ways. He soon tore away the cheap and temporary affair built to comply with the law under compulsion, and has erected in its place a substantial ladder that will last for years. A fish ladder is but an artificial imitation of the means by which river fish in their annual migrations pass up rapids. After reaching the foot of a rapid the fish rest; they will then suddenly dart up the stream and seek shelter in the slack water behind some rock; here, after more rest, as if to recover strength for the next great exertion, they will dart again and get behind another rock; and so on, until the rapid is passed. From the description given of an ordinary fish ladder, it will be seen that they are easily built and that the cost is but a trifle. The average cost of all fish ladders in Maine, including permanent stone structures over manufacturing dams, does not reach two hundred dollars. Many statistics have been kept showing the increase of fish as a result from the construction of fish ladders, especially in Great Britain. As an illustration, I quote from the report of Charles G. Atkins, Esq., Fish Commissioner of Maine. In comparing the salmon fisheries of Europe with those of Maine, he says: "Their fisheries were nearly exhausted through excessive fishing and the erection of barriers, and by a careful management, including the construction of fish ways, have been made to yield large returns. I will instance the river Galway in Ireland. The salmon fisheries of the Galway are owned by Thomas Ashworth, who came into possession of them in eighteen hundred and fifty-two. They were in an exhausted condition. Mr. Ashworth had good fish ways built over the dams, of which there was one at the head of the tide; had fishing restricted and protection given to the fish on their breeding grounds. What success attended his efforts is shown by the annual catch as exhibited in the following table:

YEAR.	Salmon.
Eighteen hundred and fifty-three	1,603
Eighteen hundred and fifty-four	3,158
Eighteen hundred and fifty-five	5,540
Eighteen hundred and fifty-six	5,371
Eighteen hundred and fifty-seven	4,857
Eighteen hundred and fifty-eight	9,639
Eighteen hundred and fifty-nine	9,249
Eighteen hundred and sixty	3,177
Eighteen hundred and sixty-one	11,051
Eighteen hundred and sixty-two	15,431
Eighteen hundred and sixty-three	17,995
Eighteen hundred and sixty-four	20,512

"Thus the produce of this fishery rose in twelve years from one thousand six hundred and three to twenty thousand five hundred and twelve, and this in spite of a dam at the head of the tide, where five sixths of all the water is used by mills and canals, only the *one hundred and sixtieth part* running through the fish way, where all the salmon must pass; in spite of civilization, in spite of the disappearance of forests and the cultivation of the land. The fish way through which pass all the salmon that ascend this river is supplied with water by a gate two feet square, and through this aperture forty thousand salmon are estimated to have passed in one year."

The law, so far as it relates to fish ladders, appears to operate satisfactorily. Thus far all mill owners on the Truckee and its tributaries, whose dams obstruct the passage of fish, have, with one exception, constructed fish ways. The Commissioners have furnished many mill owners with plans for the construction of fish ways. From our experience during the past two years, it would seem that as a rule the mill owners, with but few exceptions, are a body of intelligent men, who only require to have made clear to them the fact that the construction of fish ways does not interfere with their business, while it adds to the public good, to induce them to place fish ways over their dams.

SALMON.

The salmon is the most important visitor to our rivers. It has appropriately been called the "king of fish." The richness of its flesh, its large size, the certainty of its annual return from the ocean, the rapidity with which, under favorable conditions, it is multiplied, all render it an important article of human food. It has probably been the chief source of subsistence to more people than any other fish. The question as to whether the number of salmon is gradually decreasing in the Sacramento and San Joaquin Rivers seems difficult to be answered. Some of the fishermen contend that it is, and others point to the catch of eighteen hundred and seventy in proof that it is not. There are no fish weirs to trap them, and but few dams on the tributaries of these streams to prevent them from reaching their spawning beds. The weight of testimony is on the side of those who believe the quantity to be decreasing; and the most intelligent of the fishermen are so firmly convinced of the fact that they ask that a law be passed and enforced to prevent, for a certain period, the catching of fish while they are filled with ripe spawn. But there is no concurrence as to when this "close time" should be. The fishermen in one part of the river say it should be at one time, and the fishermen in other parts say it should be at others. When the great army is passing by Rio Vista, it would be, in the opinion of the fishermen of Rio Vista, a proper season for a close time at Sacramento and Tehama; and when this army has reached Sacramento, it would, in the opinion of the Sacramento fishermen, be a proper season for a close time at Rio Vista and Tehama. What would be just to all the fishermen, and give the next generation a chance to eat this delicious food, would be to prohibit, by strict law, rigidly enforced, the catching of salmon by any process during twenty-four hours each week; say, from midnight of Saturday to midnight of Sunday. Probably the most serious cause for the decrease of salmon in our rivers arises from mining. It is the most serious, because it cannot be remedied. Formerly salmon were plenty and largely caught by the Indians in Feather River, in the Yuba, and in the American; but of late years they have ceased to visit these rivers. It is not because the waters of these rivers are muddy. All migratory fish that seek rivers in which to deposit their spawn, do so in the season when the freshets cause the water to be muddy. They will pass through muddy water, if beyond they find clear water and clean gravelly bottoms. The gravel beds that formerly existed in these streams are now covered with a deposit of mud, washed down from the mines; and on this the eggs of the salmon will not hatch. Neither will the eggs of the salmon or trout hatch in water containing any considerable quantity of sediment. A small quantity of the finest sediment deposited on the egg prevents it from hatching.

Salmon, after the second year from being hatched, pass the greater part of the time in the ocean; they there find their principal food. While in fresh water their growth is slow, in salt water they increase in size and weight with great rapidit . They can only breed in shallow streams of cool, fresh water, such as they find in the tributaries of our rivers descending from the mountains. To such places they annually resort; and to reach them, they will make the most extraordinary exertions. Salmon are caught by the Indians in the small streams that empty into the Sacramento from the sides of Mount Shasta, at an elevation of more than four thousand feet above the level of the sea; to reach which they must have passed through at least fifty miles of almost continuous rapids. Bishop Farr states that salmon are also caught in the headwaters of Snake River, east of Salt Lake. As Snake River is a tributary of the Columbia, these fish must annually make a journey into the interior of more than a thousand miles from the ocean.

Some breeding fish enter our rivers during the Summer, but they do not deposit their eggs until late in the Autumn. During the time they remain in fresh water they lose in weight, and the quality of their flesh deteriorates; its color becomes nearly white, and it ceases to be firm. The great army arrives in our rivers after the first heavy rains. Upon arriving they seek the brackish water in the vicinity of where the salt and fresh waters meet. Here they remain for several days, or perhaps weeks. It is supposed that the brackish water kills the small parasites which attach to them in the ocean. It is this instinct that retains them in brackish water that gives to Rio Vista its prominence as a fishing point.

The salmon, like most other fish, reproduces its kind from eggs which are extruded from the female fish in an undeveloped and infecund state. The male fish performs his office of fecundation after the eggs are in the water. It is a remarkable fact, that the salmon will return, year after year, to deposit its spawn in the particular stream in which it was hatched. Salmon hatched artificially in Scotland and kept in breeding ponds, were, for several years, marked before being dismissed to the ocean; the salmon, thus marked, invariably returned to the stream in which they passed their infancy, and, so far as is known, these marked salmon have never been taken in any other river. The pair, having arrived in their parent stream, find a gravel bed, where the water is clear and cold. The female burrows a hole in the gravel, about four inches deep, and of a diameter nearly equal to her length, then pressing her body against the upper edge of the hole, the eggs are extruded and fall into this nest. The male, who is in close attendance, extrudes his milt into the water which flows over these eggs, and they are thus fecundated. The female immediately busies herself in covering the eggs with the gravel. This process is again repeated in a few days, as more eggs become ready for extrusion, until the season's work is over, when the fish return, poor and thin, and, after remaining for a short time in brackish water, leave for unknown places in the ocean, to return the following season, largely increased in weight. The only condition requisite for the hatching of the eggs is, that cool pure water, free from dirt or sediment, shall constantly pass over them. In from ninety to one hundred and thirty days the young fish are hatched. For the first twenty or thirty days they require no food, other than the yolk sac which is attached to them. The young fish remain in the river from one to two years before leaving for the ocean. It has been observed in Scotland, where the artificial breeding of salmon was first largely practiced, that of a given quantity of eggs hatched in one season, about one half the young fish would leave for the ocean the same year, while the other half would remain until the following season. This has been found to be the unvarying rule. No reason has been assigned why this migratory instinct should control but about half the young fish in the year in which they were hatched, other than that Providence, while apparently not caring for the individual, makes stringent laws for the preservation of the species.

The preservation of our salmon fisheries is a subject of great importance. Salmon were formerly as abundant in the rivers of New England as they are now in California and Oregon; but traps, weirs, pounds, seines, gill nets, and the erection of dams without fish ladders, at last nearly exterminated them. Now these States are making appropriations for the artificial hatching of these fish, and the rivers are being successfully restocked.

So much more is known of the habits of the salmon than formerly, that it is not difficult to determine what may be done to increase the number of fish, and at the same time increase the quantity that may be caught. The men who pursue the business of fishing for salmon, appreciate the necessity for their preservation and acknowledge the propriety of laws requiring a "close time," as well as laws against pounds and weirs, and laws regulating the size of gill nets. We believe the time has arrived when the present and future interests of California require careful and just legislation. We would, therefore, recommend that a standing committee be appointed in both Houses of the Legislature on coast and inland fisheries. These committees could visit the fishermen, and, after learning their views, so amend the present law and frame new laws as to protect legitimate fishing, and at the same time provide for an increase of fish in the future.

TROUT.

This fish is found in nearly all of the streams that discharge into the Pacific ocean from the Coast Range of mountains and in the greater number of the mountain streams of the Sierra Nevada. They vary greatly in size and appearance in different waters and at different seasons, but so far no variety is exactly similar to any of the brook trout of the New England States. The large brown and silver trout of Lake Tahoe and the Truckee River are pronounced by Mr. Seth Green—who is considered to be an authority in such matters—not to be trout, but species of the sebago or land-locked salmon. These fish make annual migrations from Lake Tahoe to the brackish waters of Pyramid Lake. Many of the fishermen of Tahoe insist that the so-called silver trout does not leave the lake, but as they are occasionally caught in the river, it is probable they also migrate, but perhaps at an earlier or later season. The habits of the trout are similar to those of the salmon. It seeks a bed of gravel or coarse sand in clear running water, near the head of a stream, burrows a nest and covers its eggs. In the streams of the Coast Range of mountains the trout spawns in November and December; in the streams of the Sierra Nevada in March and April. Trout will also spawn and the eggs will hatch in lakes which are supplied by springs that rise in the bottoms. In this case they will deposit their eggs among the gravel where the spring rises, the motion of the water from the spring having the same effect in bringing the eggs to maturity as the water in a running brook. It has been observed that there are no trout in our mountain streams above large falls. The trout will migrate from one part of a stream to another. If there were ever trout above these falls they would pass below them in their migrations, and the falls prevent their return. In many places a very little work would create a passage for the fish, which would have the effect of greatly increasing the numbers of this most delicious species. The reports of our assistants, from which we have largely copied, will show how rapid has been the destruction of the trout in this State. It is to be hoped that the dissemination of intelligence as to the construction of fish ladders and the enforcement of the law against trapping and illegal fishing, as well as the stocking of streams and lakes in which no trout were found, and the restocking of those from which they have disappeared, will have the effect to repair the waste that has been committed. It having been noticed that on many streams on which there were sawmills, the trout after a few years disappeared, it was supposed that the floating sawdust in some manner killed the fish, but as in other streams on which there had been sawmills for years there were still trout to be found, the Maine Commissioners devoted much investigation to solve the mystery. They found that trout readily swam among the floating sawdust, and never seemed to avoid it. At last they ascertained that where the mills were below the gravel spawning beds of the trout the fish were still plenty, but where the mills were above the fish had ceased to be. Wherever the sawdust had sunk and covered the spawning beds, the trout, after a few years, had disappeared, for the trout has the same instinct as the salmon—it returns to spawn in the particular stream in which it was hatched.

Canada, which is in advance of most of our States in her laws for the preservation of her fisheries, forbids, under penalties, all sawmills from running sawdust into the streams. In a short time it will be requisite to pass similar laws in this State, for, in addition to the destruction of trout, the sawdust will cover the spawning beds of the salmon as effectually as the mud from mining has their gravel beds in the American, Yuba, and Feather Rivers. On the Truckee River, about five miles above the Town of Truckee, the Brothers Comer have an establishment for the artifical hatching of trout. They have been engaged in this business for the past three years, and have successfully hatched and have in their ponds more than half a million of fish. Their business is a success in every respect except financially. There is not in this State, as yet, a large demand by individuals for the young trout to stock streams, and the feeding of so large a number of fish kept in small ponds requires a considerable outlay. The Commissioners have been requested to expend some portion of the appropriation at their disposal in purchasing a part of these young fish to be placed in streams that are now without trout. It would be an appropriation of money within the spirit of the law, but there is some doubt as to whether the wording of the Act authorizes this kind of expenditure. Several of the States have hatching houses in which various kinds of fish valuable for food are hatched, and distributed to all who desire to stock lakes and streams. The destruction of our native fish has not gone so far that a similar plan is required in California, but we believe it will be found that the drought of the past two years will have had the effect of materially decreasing the trout in all the streams. The sand and gravel beds at the heads of streams where they deposit their spawn must, to a great extent, have been bared by the receding water before the eggs came to maturity. If authorized, we will expend a portion of the appropriation in purchasing young fish to be distributed to restock streams, or to place in streams and lakes which have no trout in them.

The Comer Brothers procure their eggs for hatching from the fish caught in the small streams that discharge into Lake Tahoe. Their plan of operation is similar to that of other breeders of trout. Having caught a number of trout, male and female, at the season when they commence to go up stream, they are kept in a small trap or pound until the females are found to be ready to deposit their eggs. This can be readily told by an examination of the fish. The first operation is to procure a tin pan or other shallow vessel of water, a male trout is then taken from the pound and his belly placed in the water in the pan, a gentle pressure of the hand will express a few drops of the milt; he is then returned to the pound; a female trout is then taken, and by the same process her eggs are also expressed into the same pan. The water in the pan is then gently stirred so as to insure all the eggs coming in contact with the milt. In a few minutes the water containing the milt is washed away and replaced by pure water. These impregnated eggs are then placed in the hatching boxes, which are a series of shallow wooden boxes nearly filled with fine gravel, over which a stream of pure cool water is slowly but constantly passing. A trout yields from five hundred to four thousand eggs, depending upon its size and age. A salmon yields an average of a thousand eggs to each pound of its weight. The eggs are spread upon the gravel, and after the water has continuously passed over them for from forty to eighty days, depending upon its temperature, the young trout make their appearance. They require no food for the first thirty days, the yolk sack of the egg, which is attached to them, affording nourishment during this period. After this, the Messrs. Comer feed them on finely chopped liver until they are sufficiently large to be turned into the ponds, where they are fed upon any kind of coarse meat or fish, finely chopped. Trout will live and thrive in water of a temperature between forty and sixty-five degrees. This is about the only question to be settled by persons who desire to stock streams with trout. If the water in summer does not get warmer than sixty-five degrees, the experiment may be tried with every probability of success. The quality of the water does not seem to be material. They live and thrive in water that is impregnated with minerals, and in salt water, and in artesian well water, provided only the temperature is not too warm. Persons who live near small lakes and streams, now without fish, and containing water of the proper temperature, could, at trifling expense and care, provide themselves with a constant supply of delicious and healthy food by hatching a few eggs, or by turning in a few of the young fish. Both eggs and young fish are readily transported almost any distance. Salmon eggs have been taken from Scotland to Australia and hatched, and the Acclimatization Society of San Francisco has successfully imported the eggs of the Eastern brook trout and hatched them in this State. It has been estimated that an acre of water can be made to yield as much food as four acres of average land.

SHAD.

Your Commissioners made arrangements with Mr. Seth Green, the noted pisciculturist of Rochester, New York, for the importation of a lot of young shad to be turned into the Sacramento River. No shad proper (*alosa præstabilis*) are found in the rivers of the Pacific Coast, while there are found several varieties of the same family, such as herrings, anchovies, and sardines. As shad readily enter rivers while muddy from the spring freshets, and spawn in water of a temperature as high as sixty five degrees, there was reason to hope that if the shad could be brought here alive and turned into the river they would find suitable food, and in time go to the ocean and return to propagate their species. As the shad is very prolific, each full grown female yielding from fifty to eighty thousand eggs, and as the flesh is esteemed to be nutritious and valuable food, it was deemed proper to make the first experiment of importing new varieties with the young of this fish. The eggs of the shad are hatched in from two to four days after they are spawned, therefore, if there were no other reason, time alone would prevent the importation of the eggs.

Mr. Green felt so much doubt as to the possibility of transporting the young fish for so great a distance that he determined to superintend the experiment in person. He left Rochester, New York, with an assistant, on the twentieth of June, with fifteen thousand of the young fish just hatched, contained in eight tin cans holding about twelve gallons of water each. The water had to be changed at every convenient opportunity, and as on a part of the journey the weather was quite warm, constant attention had to be given to prevent the water in the cans from reaching a higher temperature than eighty degrees. At Chicago he lost a few fish from a film of oil from the machinery of the waterworks with which the water attempted to be used was covered. At Omaha the river water killed a few; the cause of this he had not time to investigate. The water of Bear River (discharging into Salt Lake) and the waters of the Humboldt and Truckee Rivers were found to agree with them and containing plenty of food. Mr. Green arrived on the twenty-seventh of June. As it was advisable to put the young fish in the river at as high a point as was practicable, for the reason that the instinct of the shad is, like that of the salmon, to return to spawn at the same place where it was hatched, they were the same day transferred to the cars of the California and Oregon Railroad and taken to the Sacramento River at Tehama. Here the temperature of the water was found to be sixty degrees of Fahrenheit. Upon dipping up the river water in a glass and pouring a lot of the young fish into it, they were found to be lively and the water to contain large quantities of some minute substance on which they feed. All the conditions being favorable, they were turned loose in their new home. It is expected they will remain in this river until about January, by which time they will be three or four inches long; they will then go to the ocean, to return the next year weighing from a pound to a pound and a half, ready to commence the increase of their kind. Thus far the experiment has been a success. The water of the river is adapted to them; it contains the proper kind of food for their young, and the waters of our coast are filled with the sand flea, a small species of the shrimp, on which the fish feeds after reaching the salt water. The only thing to be feared is that there may be in the ocean some kind of fish which may so completely exterminate them that none will be left to come back and spawn. If after one or two years even one shad is taken in the river, the result will be satisfactory, as it will demonstrate the fact that all the conditions are favorable to their successful propagation in the waters of our rivers; we could then at trifling expense fill our waters with this valuable fish. When first hatched, and in a condition proper to be transported, one freight car would bring over two million of them. If, after two years, none should be taken, it would not then be well to abandon the experiment.

The English, year after year, shipped impregnated salmon eggs to Australia; the eggs hatched, and the young fish in due time went to the ocean; but for years none were found to return. Some fish—supposed to be the bonita—destroyed them all. At last, after repeated experiments, some escaped, and in eighteen hundred and sixty-seven, large fish, returned from the ocean, were taken in the river. Shad were formerly plentiful in all the rivers emptying into the Atlantic Ocean from Georgia to the St. Lawrence. They, therefore, frequent warmer waters than the salmon. Over-fishing, traps, pounds, weirs, small meshed seines, and dams without fishways at last nearly exterminated them. Through the efforts of the Fish Commissioners of the several Eastern States they are again becoming plentiful. For a number of years all efforts at the artificial hatching of the eggs of shad had been failures. It was ascertained that the fish came into the rivers at about the same time as the salmon, but that unlike that fish, they did not spawn until the warm Summer months. Their eggs are not placed upon gravel, but float in the water. Schools of them will play about the river for days, when, upon some sudden impulse, the milk from the male and the spawn from the female will be exuded into the water, at times, it is said, making the water cloudy. In from two to four days the eggs hatch, when the young fish immediately swim for the centre of the river, keeping their heads against the current. At last Mr. Seth Green, after much patient investigation and numerous experiments, invented a box, the bottom of which was covered with fine wire netting. On this wire netting the impregnated eggs were placed; a series of these boxes, fastened together by a rope, were allowed to float in the current of the river. To the sides of each box were fastened, at an angle, pieces of board, which, floating in the water, caused the wire bottom of the box to be partially turned against the current. The effect was that the current, entering through the wire netting, kept the eggs in constant motion. All the conditions of nature were satisfied, and the experiment became a success. Mr. Green obtained a patent for his invention, which, as it is largely used, is quite valuable. Within the past four years, under the direction of Fish Commissioners and by aid of small appropriations, more than five hundred million shad have been artificially hatched in these boxes in the rivers of the Eastern States north from Virginia. The result of the first and second year's hatching in the Hudson and Connecticut is becoming manifest; more fish have been taken this year in those rivers than in any year during the past twenty. So many fish were caught that the fishermen were unable to take care of them, and fresh shad were sold in the New York City markets as low as ten cents a shad.

These results, from the experiments of enthusiasts, in increasing almost without expense the food supply of the people, are worthy the attention of statesmen. So much attention is now being given to the subject that Congress has passed a law appointing a Commission to investigate our river and coast fisheries, learn the habits of the fish, and report as to what legislation is required to aid in increasing the food supply from this source.

IMPORTATION OF NEW VARIETIES.

Your Commissioners have it in contemplation to attempt, at the proper season next year, the importation from the East of white fish from the great lakes, to be placed in Lake Tahoe; black bass, a superior game fish, to be placed in some lake to breed and be distributed; eels, to be put in the Sacramento River; and lobsters, to be deposited in some appropriate place in the bay of San Francisco. We have also opened a correspondence with gentlemen in China, with the object of learning what valuable food-fish can be obtained in that country, and the processes of the Chinese, who are said to pursue largely the artificial hatching of fish. From the following extract from one of the letters received it will be seen that the Chinese have not yet learned how, artificially, to impregnate the spawn, but depend upon catching the eggs for hatching after they have been naturally fecundated. Our correspondent says:

"Referring to your letter of May twenty-fifth, inquiring concerning the manner of breeding fish, we would say that we find the Chinese, at certain periods of the year, spread their cloths across the river at some distance above Canton and catch the eggs which are washed down from the smaller streams and ponds higher up. These eggs have been already impregnated by the male fish at the place in which they are laid, and when thus caught are placed in ponds, where after a short time they hatch and are thus raised. There are no breeding ponds near Canton, and it is said to be impossible to breed fish in ponds on any large scale, as the eggs are devoured by the male fish after impregnation unless he be immediately removed, which is impractical where there are any number. The ponds in which the eggs are placed for hatching must be running water. We would suggest the plan of sending two or three men, acquainted with the process of breeding, to California, where they could experiment on the rivers and lakes, which very much resemble those in the country where it is at present practiced."

EXTRACTS FROM REPORTS.

Our field is so extensive and there is so much to be done in the way of investigation preparatory to intelligent legislation on the subject of inland fisheries, that we deemed it advisable to employ two assistants—the first, Captain E. Wakeman, to examine and report on the fisheries of the Bay of San Francisco and some of the rivers that discharge their waters directly into the Pacific Ocean; the other, Mr. George C. Haswell, to examine and report upon the fisheries of Lake Tahoe and the Truckee River and its tributaries. The following extracts from their reports will be found of great interest. Referring to the bay fisheries, Captain Wakeman says:

"Since the date of my commission I have visited with the yacht 'George Steers,' repeatedly, all the fishing grounds that are frequented by the Italian and Chinese fishermen in the waters of our bay. The only Chinese fishing station that I find is located a short distance to the north of the 'Two Sisters.' Here, on an extensive mud flat, are stakes or poles set firmly in the ground, and occupying an area of several miles in extent, from which poles are kept constantly set the nets, which are taken up at each slackwater of the flood and ebb tide. From twelve (12) to fifteen (15) boats are employed, having (3) three men in each boat. Shrimps are taken here and cured for the Chinese market by being boiled in large vats in salt water, then spread out on the cleanly swept ground and dried in the sun, being raked over frequently during the day. The scales or skin become separated from the meat and looks like fine sawdust. The meat and refuse is then sewn up in the best quality of bags and placed on board the Chinese junk of about thirty tons and sent to San Francisco, from whence it is shipped to China. Scarce any class of fish are taken in these nets but shrimp, and thousands of tons must find their way to China annually. Their nets are similar to those used by the Italians, with this difference, viz: the middle of the net, which assumes the character of a bag, is, with the Chinese, opened by untying a string, and the whole catch is dropped into the boat with ease. The net is then closed again with the string and put back into the water to remain until next slack. Three of these nets generally load a large boat, which are all of a large and commodious class.

"Saucelito Bay is constantly used by the Italians, smelt being the principal fish, with soles, flounders, sardines, and anchovies. In some cases nothing but crabs are taken, which destroy the nets and irritate the men so that they are inclined to leave them on the beach to die; but I have had, in all cases, everything that was not marketable put back into the water. In fact, crabs are the only fish that are left upon the beach, all other kinds being taken out of the nets with tin pans, the nets being in about from one to two feet of water. All that part of the catch that is desired is taken and thrown into the boat without coming in contact with the sand and dirt, and the small fish are permitted to remain in the water; nevertheless, large quantities of the young fish die from pressure or other cause arising from the fact that they have been compressed as it were among so many thousand into the contracted space of a few feet, and are unable in their most strenuous efforts to release themselves from their perilous condition.

"They are to be found in large quantities, floating upon the water, completely drowned. Still a very large number revive, and swim off again. Whereas, heretofore, the custom appears to have been to dump the whole catch upon the beach, and, after picking out all they wanted, the young were invariably left upon the beach, becoming, in many parts, a most intolerable nuisance to persons residing in the vicinity. A new order of things has been inaugurated this year, which is found to work to the mutual benefit of all parties concerned. Five boats are generally to be found in different parts of this bay; and fish are taken at all times of tide, both day and night. Two boats are generally employed between the bay and the Golden Gate. They cast on both shores, north and south, for the same kind of fish; and also in Kashaw's Harbor, two and sometimes three boats are found both night and day, at all times of the tide. During the night fires are made upon the beach, and frequently these fires can be seen, not only on all the different beaches in Saucelito Bay and Kashaw's Harbor, but also on both sides of Raccoon Straits, giving a most picturesque and cheerful aspect during the long and gloomy nights which prevail in most parts of our harbor at this season of the year.

"These Italians are a singular and peculiar people, always sober and industrious, and, like the Chinese, they pursue their avocations in silence. During the silent and tedious hours of the night some are found sleeping in close proximity to the fire, with their harness on, face down, which appears to be the universal practice among all classes of the different races of people who are accustomed to sleep upon the ground in the open air. From Raccoon Straits to the Chinese fishing station, on the north shore, are several favorite places where the nets of the Italians are cast, with various success. The same class of fish being taken from the 'Sisters' up to Petaluma, nothing but sturgeons are found until we come to Vallejo, where there is a mackerel trap fishery.

"Down on the south shore we find two (2) Italian boats on the San Pablo flats, and two more at a favorite point to the north of Sheep Island, where there is another mackerel trap fishery.

"Two boats are employed at Sheep Island. They not only cast upon the beach, but generally fish at night under sail only, pulling round and towing the nets. The same fish, smelts, flounders, sardines, anchovies, and soles, are taken here.

"Two boats are frequently employed around Goat Island, two at Oakland Wharf, and two at Alameda Wharf. Large quantities are taken all along the Alameda Flats, some ten miles to the southward of Alameda, and on the west coast from Redwood Slough, all along until we come to Baybien, where there is a favorite resort to repair and dry their nets and take out their boats. From there to Long Bridge boats are generally engaged, and I have in all cases, at each of these points, impressed upon the minds of these men the consequences that will attend any infringement on their part of the laws in regard to the fish interest, and especially of section number six. I have also, in most of these places, made arrangements with those who live near the beach to inform me of the first infringement, by taking the name or number of the boat.

"I am informed from a reliable source that a most wanton course of destruction is practiced by the settlers along the Sacramento and San Joaquin Rivers, which will, if not arrested, be attended with vital consequences, amounting to a total destruction in these waters of our salmon fisheries, which, to the State, are worth millions of dollars.

"Perch, flounders, shrimps, and herring spawn in December; smelt, in August."

From Captain Wakeman's report on the fisheries of some of the coast rivers we make the following extracts:

"In pursuance with your orders of the sixth instant, I have examined all the streams from Spanishtown to Pescadero, and herein submit my report in regard to their character as trout streams, their obstructions, and consequences arising therefrom:

"*Pilarcitos Creek*—Upon which Spanishtown is located, is a dirty red stream, of about two feet wide and one foot deep, and empties its waters upon the beach, about half a mile below the town. There is a steam flour mill here, but no sawmill, and judging from the thick, muddy water, nothing but catfish can live in it.

"*Gobethey Creek*—Two miles below Spanishtown, is a clear water trout stream, about two feet wide and a few inches deep, and empties its waters upon the beach. There are no mills upon this stream, and only natural obstructions, such as old decayed trees and their branches.

"*Purissima*, or Pure Water Stream—Is two miles below Gobethey Creek, and is a fine clear water trout stream, about four feet wide and a foot deep. Generally at this season (February) it has a volume of about ten feet in width and five feet in depth. It empties its waters upon the beach about half a mile below the Purissima House. Four miles up the stream is the sawmill belonging to Messrs. Boyden and Hatch. This mill has an overshot wheel, the water to run it being taken from the stream three fourths of a mile above and carried in a sixteen-inch flume, at the head of which are four little dams, made by throwing a short log across and tamping it tight with a few bags of sawdust. This throws all the water into the flume and only half fills it, which shows that this stream is very small at the present time. A site for a new steam sawmill is being located two miles further up. The sawdust and blocks of the redwood are thrown into the stream, which turns the water to a dark red, and, in some places, to an inky black; in other places to a purple. This is poisonous, and kills the fish in half an hour after it is drank, according to the testimony of Messrs. Boyden and Hatch themselves. Cattle along this stream are walking skeletons. I saw several carcases of dead animals lying along the bank, notwithstanding there is plenty of good grass. This shows conclusively the truth of all the reports made to me by many of the settlers along the stream. In places where the water runs fast it is quite palatable; but where it is still it becomes wholly unfit for use, and not only kills the fish, but is dangerous to the cattle. At some seasons of the year the settlers are obliged to sink holes or wells back from the stream, and even then the water is impregnated with an odor only to be derived from dead fish.

"*Lobetis Creek*—Is a clear water trout stream, two miles from Purissima, about three feet wide, and a foot deep. It empties its waters upon the beach, and has no mills—nothing but natural obstructions.

"*Tunis Creek*—Is a clear water trout stream, of about the same volume as Lobetis. It empties its waters upon the beach. Ten miles up this stream is Foment's steam sawmill, not running now, owing to a lawsuit pending and an injunction from the Court; which last, it is to be hoped, may continue for all time, as the sawdust, so fatal to the fish and injurious to the farmer, is prevented thereby from being dumped into the stream.

"*San Gregoria*—Is a fine clear water trout stream, four miles from Tunis, and connects with the ocean about one mile below the San Gregoria House. At full sea, the salmon, of from fifteen to twenty pounds, and the silver salmon, from two to fifteen pounds, enter this stream during their spawning season, which is from October to March, when they go out to sea again. These fish have been taken several miles up the stream during the rainy season, when, owing to the strong current, most of the sawdust had been washed out. Six miles up this stream is Templeton's steam sawmill, and a few miles further up, on a northern branch of this stream, is Gilbert's sluice mill, and a few miles further up the same branch is L. P. Pharis' steam shingle mill. All these mills dump their sawdust and blocks into the stream, which so poisons the water that it has become an intolerable nuisance to all the settlers along the stream below, and will soon exterminate the trout.

"*Pompona Creek*—Is four miles from San Gregoria, and is a clear water trout stream of small volume emptying upon the beach. No mills; plenty of trout.

"*Pescadero stream*—Is three miles from Pompona Creek, and is a fine clear water trout stream, empties into the sea about two miles below the town, and connects, one mile from the beach, with the Butena River, which is also a fine clear water trout stream running to the southeast; is about twenty feet wide, and six feet deep. For six miles this makes a fine resort for the salmon and silver salmon from the sea which frequent these waters, with other lesser sea fish, for the purpose of spawning. From October to March, a wagon load of these beautiful fish, weighing from two to thirty pounds, are taken daily and sold all along the road, as high up as Spanishtown, at seventy-five cents per pound. These fish are only taken during the spawning season, they being a deep water fish and go out to sea in March. Three miles up the Pescadero stream—which is about four feet wide and a foot deep, at present—is B. Hayward's steam sawmill, and three miles further up is Anderson's sawmill, run by a turbine wheel, having a well constructed dam, built of hewn logs, well secured right across the creek. The dam is twenty feet long and about ten feet high, built in eighteen hundred and sixty-two, and all the water from above passes at present through the sluiceway at the turbine wheel. As the water has never been half way up to the top of this dam, since it was built, no fish have ever passed. A sluice box with stop waters in it for fish could be introduced through this dam near its base and outside the sluiceway for the wheel, this being the only place where the box could reach the water below, as all the rest of the bed of the stream is dry. Large quantities of sawdust and blocks are deposited in the stream below the dam; fish are found dead, their eyes eaten out by the strong poisonous acids in the water, and their bodies covered beneath the skin with disgusting blisters, like the small pox, whilst the inside is as black as ink. The waters are rendered at times wholly unfit for use. Eight miles further up this stream is Wolf's steam sawmill, the lumber from which is hauled out to the eastward, whilst the sawdust is conveyed down the stream, fatal to the fish and to the interests of everybody. There is but one sentiment existing among the settlers along the streams, and it is this: that they have arrived at a point where forbearance ceases to be a virtue, and have resolved to exhaust all legal measures, by their united efforts and similar means to protect their interests against the oppressive and persistent practice of the mill owners in dumping the saw dust into the streams, whereby the whole community below suffer, some hundreds and others thousands of dollars. The effects of the sawmills, during eighteen or twenty years, are scarcely perceptible in these almost impenetrable forests, and the united efforts of many mills for the next twenty years will be required before the woodman's axe will have wrung from the settlers of this nature's retreat in her solitude that beautiful prayer of 'Woodman, spare that tree.'

"I have communicated with many of the settlers along the banks of all these streams, and have the experience of the oldest settlers in this part of the country, and there can be but one conclusion in regard to the fish interest of these streams, and that is that the redwood sawdust poisons the water, and unless some other method be adopted to get rid of it, such as burning it or repairing roads with it, there will not be a breed of trout left in a few years. Where thousands were taken daily (thirteen hundred by one person), now scarcely a trout can be seen. If there are laws to protect them I can see no good reason for not enforcing them, and if this be done every man's table in this district will be abundantly supplied with trout—a healthy and cheap article of food—while large quantities will find their way, as a luxury, to the rich man's table at a distance, so long as these streams shall flow 'from the mountain to the sea.'"

From the report of Mr. Haswell on the Truckee River and Lake Tahoe we make the following extracts. He says:

"Under your appointment, and in accordance with your instructions, I proceeded to that point on the Truckee River where it crosses our State line on its way to Pyramid Lake, in the State of Nevada. From thence I followed it up to its head, in Lake Tahoe. I also examined the California part of that lake; also Donner Lake and Donner Creek; but from want of sufficient time could only make inquiries about the Little Truckee and its sources, Webber Lake, and Lake Independence, though prior to my appointment I had visited them all for health and pleasure.

"During this official visit I heard and saw so much that requires the most stringent legislation in both States that I scarce know where to commence my report. But as a preliminary I suggest that carefully drawn laws, precisely similar in all respects, except the mere verbiage that is necessary to designate which State enacted them, be passed by each State, and that, if such a law is not unconstitutional, each Act shall authorize the officers of the other State, armed with a proper writ from it, and any citizen of the other State who has seen the offense committed within its borders, to cross the line and make the necessary arrest, and without further ceremony take the prisoners back for trial. This seems arbitrary, but if it can be constitutionally made a law it will be found to be one of the greatest safeguards to the joint fisheries.

"Trout commence running up the Truckee, from Nevada, with the first sufficient rise of the river. The date of this, as also that of their return, is of course variable. They retire towards Pyramid Lake as the water recedes in the Summer or Fall.

"From the obstructions hitherto placed in this river and the various means used to entrap the fish before they reach the shallow, gravelly streams, together with the wholesale waste of them and the criminal destruction of their spawn, I believe that in a very few years the great lakes of both States will be entirely without brown trout, and certain, very few silver ones, unless the two State Governments concur in some such law as that above suggested. But to return to my starting point—the Truckee at the boundary line.

"The first mill and dam (all the mills on this river are for sawing lumber) on the Truckee in California, is that of Pray & Bragg. At present it is little or no obstruction to the free run of the fish, and its owners have agreed that if it becomes one they will either open the dam itself or construct proper fish ways and ladders.

"The Boca Mill Company comes next. Mr. Doane, the resident partner, is about as enthusiastic on the subject of letting the trout have a clear passage to and fro between the lake and streams of this State and those of Nevada, as the members of your body themselves. At this dam there are two good fish ways—one on a plan recommended by yourselves, and the other built upon a design which Mr. Doane and the other members of the company think superior to it.

"The dam of the Marysville Company follows, then that of the Geissendoffer Mill Company, then in succession two others known as Proctor's. Neither one of these four is an impediment now. The mills have been removed, the sluiceways are open, and the dams themselves are all so dilapidated that the fish can pass through either of them.

"Succeeding the upper Proctor mill come five dams belonging to the Truckee Lumber Company. Four of these are mere dams to catch water when the river is low. They cause no hindrance whatever. The other one has an excellent and very efficient passageway, but a log got entangled in it and carried off a portion of the crossbars or resting places. The owners said that the necessary repairs should be made forthwith; and as they seem to take as much pride as the owners of the Boca Mills do in giving the trout fair play, I do not consider that it requires any further attention.

"I am sorry that I cannot say the same of the next place—Rusch's Mill. Here is a so-called fish way which is of no possible use if it was constructed with a view to allow the fish a passage up stream. If, on the contrary, it was built to be a most efficient trapping place, the intent was fully carried out. But the owner has promised that no further action need be taken, as he would as soon as possible either build a new passageway or else alter the present one to meet the requirements of the law.

"Except as above stated the fish have proper passageway in the Truckee to and fro from the State line to the debouchment of Lake Tahoe.

"According to your instructions, I returned from the lake to the line and crossed into Nevada to confer with the citizens of our sister State about opening the Truckee on their side so as to give the fish a perfect free way whenever they deemed proper to use it between the fresh waters of Tahoe and the brackish waters of Pyramid. The people there took the matter in hand. The owner of the only obstruction on the Nevada portion of the river was applied to, to either have fishways made, or in some other manner give the fish a chance. He declined; but a little giant powder, used by some unknown hand, made the condition of things about that dam entirely favorable for the trout to indulge their migratory propensities.

"Donner Lake empties through a short creek, also called Donner, into the Truckee about fifteen miles below where that river leaves Tahoe. On Donner Creek I found a dam so constructed that no fish once leaving Donner Lake on its way down to the brackish waters of Lake Pyramid could ever get back again to breed. The consequence of this is that brown trout, which I believe always yearly go or at least start to go to the great Nevada lake, Donner, are extremely scarce, whilst the silver trout, which I think never, or if at all, but seldom, go down stream beyond the lake they first reached from their hatching grounds, are moderately plentiful.

"I may as well remark here that the above is my opinion as to the one kind coming down stream out of the lakes, and the other not doing so, at least not as a general natural instinct, though individual exceptions may occur. But it is contended that there is no distinction in species between the two kind I designate as silver and brown trout—in fact, that they are the same thing—the apparent difference being merely local caused by the nature and color of the gravel in which they were hatched, and the peculiarities of the water in which they grew or live. Such may be the case, but I have examined a considerable number of both colors, and caught a good many trout in the Atlantic States in my younger days, and I consider that what I here call the brown trout is not the same as what was called the brook trout in that part of the country where I was born and brought up and caught fish. In every trout I have examined here the brown ones have a straight purplish line on each side of the body from almost the end of its nose to near the tail. This line is not on the silver ones, and on the brown ones I have never found any of the spots or dots usual on all trout below the purplish line. They have invariably been above it. If I remember correctly, the Eastern brook trout have nothing of the purplish line, but merely spots or dots. Not being an ichthyologist I merely call the attention of the Board to what I believe, from my own observation, and ask you and others who read this report to examine this question and another—are there any trout, either in this State or Nevada, except, perhaps, in the pure mountain streams further North? Whilst upon the Truckee and the lakes I heard several persons, who have the reputation of being ichthyologists, say that all the fish that we call trout, were in reality, land-locked salmon, frequently called schoodic trout. But to return to the trap on Donner Creek. I could not find the owners of this dam, but learned that they were A. C. Toll and Brothers. I afterwards understood from Commissioner Redding that they had promised him that they would either remove the dam entirely or put in satisfactory ways and ladders.

"At the source of the Truckee—*i. e.*, Lake Tahoe—two persons have been and I believe that, to some extent, they are still in the habit of taking the fish by means of seines, nets, and traps, on the alleged pretense of catching them for their spawn to stock lakes, streams, and ponds. But the fact is they catch them at all times of the year, and sell immense quantities, without reference to either spawn or spawning season; and, although I did not see it, and can scarcely believe it, I have been informed by their neighbors of credibility that fish and spawn were dipped out by the bucketfull, and either consumed on the place or sold to others for hog feed. Of course, I notified these men of the provisions of the law, and forbid the further use of either seine, net, or trap at any season of the year, or for any purpose whatever. They promised obedience, and the residents of the vicinity said that they would take care that the law was complied with, and in the event of any violation the parties should be prosecuted with the greatest rigor to the utmost extent of the law.

"At the mouth of or a short distance up almost every small stream—the trout's breeding place—that empties either into the Truckee River, or Tahoe, Donner, or other lakes, fish traps are set in such a manner as to be actual murder to most of the fish, and complete destruction to their spawn. Taking advantage of the fish's instinct of procreation and continuance of its race, and of its other instinct, that that can only be done by going up stream to shallow water and a gravelly bottom, a trap is made, which is done as follows: A row of stakes is driven across the full width of the stream. These are not placed so close as to prevent the water coming down, yet are put so near that a trout cannot get through to go up. Further down the stream another row is driven across. This is in every respect like the first, except that in one portion of it—about the centre—an opening, say, a foot wide and two or three feet long, is left under water. The distance between the two rows of stakes is a matter of option, being from three or four feet to ten or twelve, depending somewhat upon the number of prisoners the owner expects to take, and how long, and for what purpose he intends to keep them. It will be seen that the fish can get in through the lower tier but not out through the upper one, yet might escape by returning; but this they will not do. Fish always return to spawn at the spawning place of their parents. Here they are, and reasoning, nature, instinct, or whatever else people may choose to term it, tells the fish that they are of no further use in the waters of this world unless they get up the stream to spawn and milt. So in this trap they remain, butting their heads against the upper stakes until they are either taken out or the growing ova and milt compels them to violate the laws of nature and die, when the fish and what should have been their descendants are dipped out and, as already said, given to the hogs. Trout are frequently thrown out with their noses absolutely butted off in the vain endeavor to force their way through the barricade.

"The Indians, and a good many whites, have another distinctive method of trapping trout, but it is nothing like so bad as the one described above. Even where there are good ladders and ways, a large number of fish try to run up the current pouring over the dam. After repeated efforts to run up on the face of the water against the impetus with which it is coming down, they become weak and exhausted, and can no longer keep upon the face of the stream and fall through it into the vacant space that is always found under the water that pours over a dam. In this space wicker or other baskets (the Indians use willow twigs) are fastened, and into these baskets the fish fall in great numbers, and of course cannot escape.

"Two facts show conclusively that trout are fast disappearing from the lakes. One is, that very few, comparatively speaking, are caught now, even in the best seasons, with the hook and line. As a sample, I may tell of a Sacramento attorney who is noted as an expert in fishing—a gentleman who can nearly equal Izac Walton for patience in waiting for a nibble—who spent some four or five days this summer fishing on Donner. He was out by daylight, and did not return until dark, and the greatest number he caught in any one day was five. I may also state that every trout that he caught was silver—there was not a brown one in the whole number. The other fact is, that the so called chub, the natural, as it would seem, food for the trout in the lakes, have of late years increased in such numbers as almost to be a nuisance.

"On the Truckee, about nine miles from Tahoe, Comer Brothers have a large establishment for rearing trout. I understand that it was started about three years ago, and that although it has been a success so far as to growing and distributing the fish, yet, in commercial parlance, it has been something very near a failure. I was told that Webber Lake was stocked from the Truckee several years ago, and that it is now well filled with good sized fish, though formerly it did not possess any trout. If there is any means by which your Board can aid these Pioneer California trout growers, I trust that you will do so.

"I believe that I have nothing to add, except to say that during the coming year and until people begin to understand the law, and the officers and Courts enforce it, the entire time of at least one man will be required about Lake Tahoe, the Truckee, Little Truckee, and the lakes and streams that flow into them, for the protection of fish."

EXPENDITURES.

Of the appropriation of five thousand dollars made by the Legislature to aid the Commissioners in importing new varieties of fish, and in preserving the native fish valuable for food, we have expended the following amounts:

1870.		
Dec. 9th......	Paid J. D. Farwell & Co. bill of sundries.........	$40 32
1871.		
Feb. 9th......	Paid expenses of E. Wakeman, examinations Bay of San Francisco..............................	238 60
March 20th.	Paid Bugbey & Sons, drawings of fish ladders..	25 00
March 27th.	Paid expenses of E. Wakeman, coast rivers......	80 00
July 8th.....	Paid expenses of Seth Green and assistant in San Francisco	43 50
July 8th......	Paid expenses of Seth Green and assistant in importing 15,000 young shad..................	348 30
July 8th	Paid fare of Green and assistant, return trip....	186 50
Nov. 25th...	Paid expenses of G. C. Haswell, examination of Lake Tahoe, Truckee river, and tributaries..	175 00
	Total amount expended..............................	$1,137 22

All of which is respectfully submitted.

B. B. REDDING,
S. R. THROCKMORTON,
J. D. FARWELL,
Commissioners.

REPORT

OF THE

COMMISSIONERS OF FISHERIES

OF THE

STATE OF CALIFORNIA,

For the Years 1872 and 1873.

G. H. SPRINGER.........STATE PRINTER.

REPORT.

To His Excellency,
NEWTON BOOTH,
Governor of California:

The Commissioners of Fisheries for the State of California, appointed under an Act of the Legislature entitled "An Act to provide for the restoration and preservation of fish in the waters of this State," approved April second, eighteen hundred and seventy, respectfully submit their second biennial report.

REPORT.

Your Commissioners, in pursuance of the plan contemplated in their last report, proceeded to open correspondence with the most noted fish culturists in the East, and also with the United States Fish Commissioner, at Washington City, upon the subject of obtaining an additional supply of shad, and also a large variety of other food fishes, from the Eastern lakes and sea coast.

By the kindness of the United States Commissioner of Fisheries, the Hon. Spencer F. Baird, we were allowed to avail ourselves of the services of Mr. Livingstone Stone, attached to the United States Commission, and engaged in transferring salmon eggs from California to the waters flowing into the Atlantic. Mr. Stone's high reputation as a successful breeder of fish, as well as a writer upon the subject of pisciculture, not only gave us confidence in the success of the enterprise, but also led us to enlarge and amplify the scope and range of the undertaking.

In this view, we made arrangements with Mr. Stone, for him to proceed to the Eastern States, and there collect a supply of shad, eels, black bass, white fish, tautogs, striped bass, blue fish, and lobsters.

To carry into effect these plans, we chartered from the Central Pacific Railroad Company a special car, to be placed at our disposal at a given point at the East, and there to await the necessary time for being fitted up for the purpose, and to receive its freight of living fish. All the requisite arrangements for the transit of this car over the different lines of roads, as well as for its necessary stoppages and delays at different points where fish were to be taken in, had been most completely made by our colleague, Mr. B. B. Redding, through the agency of the different railroad managers; and, on the seventeenth day of March, eighteen hundred and seventy-three, Mr. Stone left San Francisco, to carry out, if possible, the plan of your Commissioners, to transport a carload of living fish from the Atlantic to the Pacific Ocean.

Referring to this expedition, Mr. Stone says:

"In accordance with instructions received from the Fish Commissioners of the State of California, I left San Francisco for the Eastern coast, on the seventeenth day of March, eighteen hundred and seventy-three, for the purpose of procuring a stock of the best varieties of Eastern fish, and transporting them, alive, across the continent, with a view to introducing these varieties into the public waters of California.

"My plan of operations for the whole undertaking was: First—To collect the fish at some favorable point at the East, where they could be kept alive until everything was ready for the journey. Second—To fit up a car with the apparatus most suitable for transporting living fish; and, third—To take this car, when loaded, to California, in the least possible time, and without any transfer of its contents. This plan was successfully carried into practice, up to the time of the accident just beyond Omaha.

"The first installment of living fish intended for the California car, arrived at Charlestown, New Hampshire—the point of rendezvous—on the seventh of May. It consisted of eighty-two black bass (*grystes fasciatus*), glass-eyed perch (*lucio perca*), and bullheads (*pimelodus*), and about three hundred thousand eggs of the *perca flavescens* and the *lucio perca*.

"These fish were collected at Lake Champlain, and at the Missisquoi River, in Vermont, and were taken a journey of thirty hours, by rail, before reaching Charlestown. They, nevertheless, bore their trip admirably, and arrived at their destination in first-rate order.

"The next two weeks were spent in fitting up the car, which had arrived at Charlestown, New Hampshire, and making other preparations for the difficult undertaking in prospect. Arrangements had been previously made, at the suggestion of the Hon. Spencer F. Baird, United States Commissioner of Fisheries, with Mr. Myron Green, at Castleton, on the Hudson, for a supply of young shad and fresh water eels; and, also, with Captain Orinal Edwards, of Woods Hole, Massachusetts, for young lobsters, and other salt water fish. The Eastern trout (*salmo fontinalis*), were to be taken from the Cold Spring Trout Ponds, at Charlestown. The large lobsters were to come from Johnson & Loring's establishment, at Boston, and Mr. Myron Green was dispatched to the Raritan River for catfish.

"The equipment of the car having been completed, and everything being ready, the third day of June, eighteen hunered and seventy-three, was set for our departure. At midnight of June second, Mr. W. S. Perrin arrived from Boston with a special car, having on board the lobsters, oysters, small lobsters, salt water eels, tautogs, and reserves of ocean water. We began at daylight the next morning filling the tanks in the car and loading in the fish, and by one o'clock in the afternoon everything was ready, and at a quarter past two, on Tuesday, June third, the California Aquarium Car started on its journey.

"The car was furnished by the Central Pacific Railroad Company, and was one of their fruit cars, intended for quick trips across the continent. It was twenty-seven feet long and eight feet wide, and was provided with a Westinghouse air brake and Miller platform, which enabled us to take it along with passenger trains.

"At one end of the car was a stationary tank, built of two-inch plank, lined with zinc, and occupying the whole width of the car, and eight feet of its length.

"This tank was two feet and eight inches deep, and held, when full, about ten thousand pounds of water.

"At the other end of the car was a large ice box, the reserves of sea water, six large cases of lobsters, and a barrel of oysters.

"In the center of the car, and occupying nearly all the room in it, were the other portable tanks for carrying the fish. Our beds were on the top of the large stationary tank, which, of course, was covered. The large tank was also arranged so that we could take on water on a large scale from the waterworks at the railroad stations en route. This proved to be a very great convenience, and was, in fact, indispensable.

"When we left Charlestown, New Hampshire, the car contained upwards of:

"Sixty black bass from Lake Champlain (*grystes fasciatus*).

"Eleven glass-eyed perch from Lake Champlain (*lucio perca*).

"One hundred and ten yellow perch from Missisquoi River (*perca flavescens*).

"Eighty young yellow perch from Missisquoi River (*perca flavescens*).

"Twelve bullheads (horn pouts), from Missisquoi River (*pimelodus*).

"One hundred and ten catfish from Raritan River (*pimelodus*).

"Twenty tautogs from near Martha's Vineyard (*tautoga Americana*).

"One thousand five hundred salt water eels from Martha's Vineyard (*anguilla*).

"One thousand young trout from Charlestown, New Hampshire (*salmo fontinalis*).

"One hundred and sixty-two lobsters from Massachusetss Bay and Woods Hole.

"One barrel of oysters from Massachusetts Bay.

"Supplies of minnows for feed fish.

"The black bass, bullheads, catfish, and part of the lobsters, were full grown and heavy with spawn.

"Besides the fish above enumerated, I took on at Albany forty thousand fresh water eels from the Hudson, and arranged for twenty thousand shad and shad eggs (*alosa præstabilis*), from the Hudson, to overtake us at Chicago.

"The receptacles for holding the fish consisted of one large stationary tank, eight feet square and two feet eight inches deep.

"One round wooden seventy gallon tank.

"One round fifty-gallon tank.

"Three round thirty-gallon tanks.

"Three conical-shaped thirty-gallon tanks.

"Six conical ten-gallon tin cans.

"One conical fifteen-gallon tin can.

"Three round nine-gallon tin cans.

"Two thirty-five-gallon casks.

"Six large cases (containing the lobsters).

"The total capacity of the whole, excluding the lobster cases, being about sixteen thousand pounds of water.

"Besides the vessels for holding the fish, the car contained the following articles:

"One large one hundred and twenty-gallon cask, filled with ocean water.

"One sixty-gallon cask, filled with ocean water.

"One large ice box.

"One half barrel of live moss.

"One half barrel of water plants.

"Curd and meal for feed.

"One bushel of salt for killing parasites.

"The aerating apparatus referred to.

"One alcohol stove.

"One set carpenter's tools.

"Two lanterns.

"Two hammocks.

"Two spring beds.

"Two mattresses and pillows.

"Two sets bedclothes.

"One broom.

"One lot green sod.

"Two thermometers.

"Pipes, spouts, and syphons, for taking in and letting off water.

"One long-handled dip net.

"Two short-handled dip nets.

"Movable steps to door of car.

"Sundry barrels, pails, dippers, etc.

"Maps, with stations marked where we knew the water to be good or bad.

"Our trunks, valises, and private baggage.

"When the car left Charlestown there were four of us in it—Mr. W. T. Perrin, of Grantville, Massachusetts, Mr. Myron Green, of Highgate, Vermont, Mr. Edward Osgood, of Charlestown, New Hampshire, and myself. We arrived at Albany at eleven o'clock and thirty minutes P. M., the same evening, all the fish doing well, and the water in the tanks standing at forty-five degrees Fahrenheit. Here we took on the forty thousand eels mentioned above, and half a ton of ice. We also left Mr. Myron Green here to go to the New York Shad Hatching Works, at Castleton, on the Hudson, and get a supply of young shad.

"On my urgent application to the New York Central Railroad authorities, that road took us with their passenger train, which was due to leave Albany at two o'clock and forty minutes A. M., on the same night. We reached Suspension Bridge about noon, and left for Detroit, with a passenger train, on the Great Western Railroad. We took on ice and water at Hamilton, Canada, and reached the boat at Detroit ferry about eleven o'clock P. M. the same day—Wednesday, June fourth—all the fish being in good order, except the lobsters, which were dying in considerable numbers. The ferry boat being just filled, without the aquarium car, they left us east of the river all night, and it being very warm, I spent the rest of the night till daylight looking up ice, of which I at last obtained about a ton and a half.

"Leaving Detroit that morning—Thursday, June fifth—we proceeded directly to Niles, Michigan, with a passenger train, via the Michigan Central Railroad. We had now come all the way with passenger trains, and had we known this beforehand, we need not have lost any time in bringing on the shad; as it was, however, we expected to make slow time on freight trains from Albany to Chicago, and I here arranged to have the shad brought on by express from Albany, two days after we left that point. These two days we had now on our hands, and it was very aggravating to be obliged to lose so much time when time was so precious. There was no help for it, however, and as I thought it would be better to wait part of the time on the road than to spend the whole of the two days in Chicago, I had the car dropped at Niles, Michigan, and we remained there till six o'clock and ten minutes the next morning—Friday, June sixth—when we went on to Chicago, after taking on ice and water, and catching some minnows to feed the large fish with. We entered Chicago about ten o'clock on Friday morning, all the fish doing well, except the lobsters and eels.

"The temperature at which I aimed to keep the different varieties of fish were as follows:

	Fahrenheit.
Catfish	50°
Fresh water eels	45° to 50°
Tautogs	45°
Salt water eels	45°
Black bass	42°
Yellow perch	42°
Bullheads	42°
Glass-eyed perch	42°
Trout	38°
Lobsters	34° to 36°
Oysters	34° to 36°

"From the experience which I have now had, however, I would advise a change with some of the fish, which would make the temperature as follows:

	Fahrenheit.
Catfish	50°
Fresh water eels	50°
Bullheads	48°
Glass-eyed perch	48°
Yellow perch	45° to 48°
Black bass	42° to 45°
Salt water eels	42° to 45°
Tautogs	40°
Trout	36° to 38°
Lobsters	34° to 36°
Oysters	34° to 36°

"Mr. Myron Green rejoined us with the shad the next morning—Saturday, June seventh—and at ten o'clock and fifteen minutes A. M. the same day, after having taken on three tons of ice and three tons of Lake Michigan water, we left Chicago for Omaha, via the Chicago and Northwestern Railroad.

"We took on water again at Cedar Rapids, Iowa, and arrived at Omaha at eleven o'clock, on the morning of Sunday, June eighth. Through the courtesy of Mr. C. B. Havens, the train dispatcher of the Union Pacific Railroad, who detailed an engine to take our car to the ice house at the Union Pacific shops, we were enabled to take on a ton and a half of ice, and about one o'clock we started westward again. We were now on our sixth day out, and everything was promising well. All the dead eels had been removed, and we had twenty thousand or thirty thousand left. The mortality of the lobsters was on the decrease, and we still had over forty alive and in good condition. All the other fish were in splendid order. We had ice and water enough on board to take us, if necessary, to the Sierra Nevada—certainly with what supplies we could get in the Wasatch Mountains, where the water is good. The circumstance of the fish having lived so well up to this time, gave us a good deal of confidence, and we were encouraged to hope that they would continue to do well to the end of their journey.

"After leaving Omaha we stowed away as well as we could the immense amount of ice we had on the car, and having regulated the temperature of all the tanks, and aerated the water all around, we made our tea and were sitting down to dinner, when suddenly there came a terrible crash, and tanks, ice, and everything in the car seemed to strike us in every direction. We were, every one of us, at once wedged in by the heavy weights upon us, so that we could not move or stir. A moment after, the car began to fill rapidly with water, the heavy weights upon us began to loosen, and. in some unaccountable way, we were washed out into the river. Swimming around our car, we climbed up on one end of it, which was still out of water, and looked around to see where we were. We found our car detached from the train, both couplings having parted. The tender was out of sight, and the upper end of our car resting on it. The engine was three fourths under water, and one man in the engine cab crushed to death. Two men were floating down the swift current in a drowning condition, and the balance of the train still stood on the track, with the forward car within a very few inches of the water's edge. The Westinghouse air-brake had saved the train. If we had been without it, the destruction would have been fearful.

"One look was sufficient to show that the contents of the aquarium car were a total loss. No care or labor had been spared in bringing the fish to this point, and now, almost on the verge of success, everything was lost.

"I immediately telegraphed the state of affairs to Mr. S. R. Throckmorton, Chairman of the California Fish Commissioners, and to Honorable Spencer F. Baird, the head of the United States Fish Commission at Washington. I received instructions, by telegraph, the next morning, to return East immediately, with my assistants, and take on a shipment of young shad to California, under the auspices of the United States Fish Commission.

"In pursuance of these instructions, I went East, and having obtained forty thousand young shad from the New York State Hatching Works, at Castleton, on the Hudson, I left Albany a second time, at eleven o'clock and thirty minutes P. M, on the twenty-fifth of June, eighteen hundred and seventy-three, in company with Mr. W. T. Perrin and Mr. Myron Green, my assistants on the aquarium car. We were also accompanied, as far as Omaha, on this trip, by Mr. H. M. Webster, whose experience in carrying live shad was, in this instance, of the greatest value.

"On our arrival at Ogden, Utah, I left five thousand of the shad, in first rate order, in charge of Mr. Rockwood, Superintendent of Fisheries at Salt Lake City, to be introduced into Great Salt Lake, and continued with the other thirty-five thousand to Sacramento, California, where we arrived at half-past one in the afternoon of the second day of July, the fish appearing in every respect as fresh and lively as when they left the Hudson a week before.

"We deposited them that night, at ten minutes past nine o'clock, in the Sacramento River, just above the railroad bridge, at Tehama, the whole undertaking, from beginning to end, having been a perfect success."

Immediately upon hearing of the loss of the aquarium car, we telegraphed a remittance to Mr. Stone, at Omaha, and directed him to repair at once to the Hudson River, and bring out, while yet in time, all the young shad which his now reduced facilities would permit.

Mr. Stone at once proceeded East, and communicating, by telegram, with Mr. Spencer F. Baird, United States Fish Commissioner, received from him not only prompt attention, but was also furnished by Mr. Baird, for the California Commission, all of the shad which the United States Commission could spare—forty thousand in number—which were immediately sent through to California, at the expense of the United States Fish Commission, under the care of Mr. Stone, free of all charges, for which, and for the many kind and valuable aids extended to us by Mr. Baird, this Commission takes this public opportunity of returning their most grateful thanks.

Upon receiving advice of the approach of this shipment, one of the Commissioners repaired to Sacramento, and there met the incoming car with a fresh supply of water and ice. The little immigrants were found to be all alive and in excellent spirits, and after receiving a fresh supply of ice and water, proceeded on their journey to Tehama, on the Sacramento River, and there, that same night, they were successfully placed in the waters which flow into the Pacific.

In the Spring of eighteen hundred and seventy-two, we opened correspondence with Mr. Seth Green, for an additional supply of shad, but the early Summer and excessive heat of the Eastern States at that time, compelled us to abandon the attempt for the season.

In the meantime, viz., in the Fall of eighteen hundred and seventy-two, we received advice of a shipment, made to us by Mr. Baird, of white fish eggs, and we immediately took measures to hatch them, and place them in the waters of the State.

In view of this, we caused an examination of the different lakes into which they could be placed with the best prospect of success, which resulted in our selecting Clear Lake as affording most of the necessary conditions. Among these conditions is an essential one, namely: that it may be seined without destroying other valuable fish, there being few or no fish in that lake, the destruction of which by seining would be any loss, or which, at any rate, would not be most profitably replaced by the white fish, which can be taken only by seining or trapping. The climate, also, of Clear Lake, seemed to us to be the best within reach, remembering always that the eggs of the white fish are very delicate, and will not bear rough transportation. As it was, in the first attempt all the eggs perished; and in the second effort, although great pains were taken, a very large proportion of the eggs perished on the way.

Having selected what we deemed a proper place, we erected a hatching house, under the charge of Mr. J. G. Woodbury, of whom we take pleasure in speaking as a skillful, careful, intelligent, and economical manager.

Mr. Woodbury conducted the hatching of these eggs with great success, and closed his labors with putting into Clear Lake twenty-five thousand living and healthy young white fish, from which we may reasonably hope to stock all the suitable waters in the State. It may be well to state, that the great object at first is to get the desirable fish here and acclimated in our waters; after that, they may be bred artificially, and distributed to any extent.

It is probable, or at least possible, that ten thousand shad may return to our waters this coming Spring, and forty thousand more in eighteen hundred and seventy-six. If such should be the case, and they are properly protected by legislation, it will be no difficult or costly matter to breed from them a million of young fish, which, in three years more, will stock the entire coast, and give us shad as plenty as we now have smelts. But, to arrive at this, we require some stronger legislation, which will absolutely prevent the taking for food of the new shad as they come in; we require them all for breeding.

If it shall be the pleasure of the Legislature to continue to aid this Commission, it is our intention, this next coming year, to renew our effort to bring across the continent the food fishes of the East, and with the experience which we have had, and the additional knowledge which we have gained, we have hopes of not only repairing our loss of last year, but largely to improve upon that effort. We regret to say that our loss was large. We had embarked in it all the remaining funds of the Commission; but no human foresight could have predicted it, or guarded against it; and we can only say that it is worth all that it has cost to know the fact that an aquarium of living fish, eels, and lobsters, provided with both fresh and salt water, can be brought from the Atlantic to within one day's travel of the Pacific, in good order and in healthy condition.

Since our last report, the Commissioners have given somewhat of their attention to placing in some of the streams and lakes different kinds of native and other fish, although they have not been able to do so much as they would desire to do were the means at their command. There is no cheap way of doing this work; everything pertaining to it requires dispatch and care. We are handling a delicate and perishable material, under circumstances in which the painstaking and expense of the most careful preparations may, in a moment of neglect or accident, be lost entirely. Consequently, we have refrained from any expensive experiments, and confined ourselves to the introduction of food fishes fully known to be profitable in other States, and the dissemination of such domestic fish as can be easily and cheaply transferred from one part of the State to another. In this way, we have, during the past season, placed some ten thousand Lake Tahoe trout in the South Yuba River. Trout from the mountain lakes have been placed in the North Fork of the American River. We have purchased from the breeders of Tahoe trout, also, six thousand trout, which have been placed in Lake Merced. We have also purchased two thousand Eastern red speckled trout (*salmo fontinalis*), which we placed in the North Fork of the American River, near the Summit. Two thousand of the same, and six thousand Tahoe trout, we have placed in the headwaters of Alameda Creek, and two thousand more Eastern speckled trout in San Andreas Reservoir, near this city.

The Commission feels greatly encouraged in its efforts to preserve and increase the fish of California, by the general interest taken by the people in this very interesting subject. On all occasions we have had the most ready aid, and in many cases gratuitous services from those with whom the operations of the Commissioners have brought them in contact, and we would respectfully suggest that we believe that the people are now willing to incur a moderate expenditure in order to have this work continued. This Commission does not believe that any large appropriation for this purpose is now necessary. Time is required to develop and perfect the successful propagation and preservation of foreign varieties of fish. We have yet a great deal to learn in regard to this subject, and undue haste and lavish expenditure are by no means the most certain way to success. It is now three years since the first attempt to bring shad across the continent was commenced. We now know that some of the shad brought here in eighteen hundred and seventy-one have lived and grown to good size. The shoal of shad are not due in the rivers of California until June, eighteen hundred and seventy-four, but we have had in our hands three specimens, which are, of course, exceptional, and we have heard of two others. The incoming fish will be breeders, and we shall require funds to enable us to establish breeding stations on the Sacramento and San Joaquin Rivers, and, above all, we require proper laws to preserve this season's arrivals. It will be seen by the accompanying statement that the entire expenditure of the Commission since its last report, has been less than six thousand dollars, and during the existence of the Commission—four years—but seven thousand. With this a great deal has been done, and the foundation laid for the accomplishment of much more.

The work is but commenced, and as we have before remarked, time in this business is a more important element than money. The most in importance is the means for preventing the destruction of the fish we already have. The Commission find it almost impossible to prevail upon the people to refrain from destroying fish in the localities where they abound. It seems as if human invention is taxed to its utmost in the desire for wholesale destruction, and the reluctance which men feel to complain of their neighbors, renders it almost impossible to enforce the laws in such cases. If the Legislature should see fit to make an appropriation sufficient to allow the Commissioners to employ, at times, a proper person to look after such violations of the fish laws and see to their enforcement, we think this evil could readily be suppressed, as the people at large show a great interest in having the law enforced, but no one is willing to make himself obnoxious by being an informer. All this would be cured by placing the means of remedy in the hands of the Commission.

The Commission already have the power to do this, and have done it with most hopeful results, so far as their limited means have allowed. It will be necessary, during this session of the Legislature, to have passed a full and comprehensive law relating to all kinds of fishing. In the first place, the whole system of fish-traps, seines, fykes, etc., should be abolished by law. Secondly, the meshes of the nets used should be regulated by law. The time of fishing for salmon should be properly limited. There come from all parts of the State constant complaints of the destruction of fish by sawdust, and the refuse from sawmills, thrown into the streams; and petitions for the enactment of laws to prevent it are now before the Legislature. This Commission will be aided by many citizens interested in these matters, in passing a law covering the piscatory interests of the State, which we hope will be favorably acted upon by the Legislature. The Commissioners have taken pains to ascertain the season of the year during which the taking of salmon should be prohibited by law. We have caused careful observations to be made of the time at which the salmon ascend to the heads of the rivers to spawn, and from all the information we have been able to obtain in that way, and by consulting with persons well qualified to afford advice from the results of practical knowledge of the subject, we would recommend that the taking of salmon be prohibited by law from the first of August to the first of November. It should be observed that the having in possession, or offering for sale of salmon, during the close term so prohibited, should be punished the same as the taking of them.

In conclusion, your Commissioners, with much diffidence, would ask the aid of the Legislature for the means of carrying on the work which they feel they have just commenced. There will be necessary, for the coming season, funds to erect hatching houses at such stations as shall have been discovered as the spawning grounds of the shad, now soon to be expected in our waters. The renewal of our effort to bring fish and lobsters across the continent, so nearly successful last year, is an earnest wish of the Commission. Our work at large remains unfinished at the time that we are best qualified to prosecute it. The amount of appropriation necessary to carry the Commission over to the next session of the Legislature is not large, and, when we consider the object to be attained, we feel that we may safely ask for a moderate sum, without laying a very heavy additional burden upon the people. The money already expended is but a trifle compared with the benefits to be derived from a like expenditure in the immediate future.

When we entered upon the duties of our office, the whole subject of fish breeding had but lately been entertained on this coast. The ground was new, and the field of operations opened to the Commission covered a large extent of country and marked varieties of climate. We have been compelled to educate ourselves to the work in hand, and to move as cautiously and economically as possible. We are willing to admit that we take great interest in the continuance of our operations; we know that we have learned a great deal about fish culture that will be useful to the State. We believe that we are now on the road to success. We are willing to give our time to it, and perhaps it is not amiss for us to make this report the means of saying that, which may not be generally known, our services are without charge of any kind to the State. We have no individual interests to subserve, and we only ask aid from the State in order that we may serve her, and carry out to completion the objects for which this Commission was created.

EXPENDITURES.

At the last session of the Legislature, an appropriation of two thousand dollars was made to aid the Commissioners in prosecuting their work, and, since our last biennial report, we have expended the following amounts:

1873.		
Jan. 25....	Paid for advertising in *Union*..................	$22 75
Jan. 25....	Paid for copying report..................................	59 50
Jan. 27....	Paid Comer & Co., for Tahoe trout for South Yuba..........	300 00
March 17.	Paid telegraph..	50
April 19...	Paid expenses of establishing hatching station at Clear Lake, expenses of hatching white fish eggs, and examination of Clear Lake, Blue Lake, and other waters..............................	547 26
May 3......	Paid Acclimatization Society for speckled trout placed in San Andreas Reservoir..................	100 00
May 5......	Paid Acclimatization Society for speckled trout placed in the tributaries of Alameda Creek...	100 00
May 10....	Paid reward for first shad taken............	50 00
June 3.....	Paid traveling expenses of Commissioners........	44 00
	Paid traveling expenses of R. H. Elam, as Fish Warden, to Santa Cruz..............................	60 00
	Paid Haight & Temple, for legal services.........	50 00
	Paid Bugbee for drawings for fish ladders.........	30 00
	Paid Cleveland for fitting up breeding troughs..	77 28
	Paid T. H. Selby & Co. for lead pipe................	38 09
June 12...	Paid expenses of defending salmon laws...........	48 25
	Paid Acclimatization Society for trout placed in American River..	100 00
July 2.....	Paid expenses of Commissioner to Sacramento to meet shad...	8 75
July 10...	Paid Comer & Frazer for Tahoe trout placed in Lake Merced, six thousand in number..........	120 00
July 14...	Paid J. G. Woodbury for services enforcing the salmon laws..	104 50
	Carried forward....................................	$1,761 88

	Brought forward	$1,761 88
	Paid Acclimatization Society for six thousand Tahoe trout, placed in Alameda Creek	120 00
	Paid expenses of placing the same	51 50
	Paid total expenses of the aquarium car bringing fish, eels, and lobsters from the Atlantic Coast to California*	3,912 18
	Total amount expended	$5,845 56

*A part of this amount will be restored by a settlement now pending with the railroad companies.

RECAPITULATION.

Amount of appropriation of eighteen hundred and seventy.	$5,000 00
Amount of appropriation of eighteen hundred and seventy-two	2,000 00
Total	$7,000 00
Expenditures, as per report of eighteen hundred and seventy, and of eighteen hundred and seventy-one	$1,137 22
Expenditures, as per report of eighteen hundred and seventy-two and eighteen hundred and seventy-three	5,845 56
Cash remaining on hand December thirty-first, eighteen hundred and seventy-three	17 22
Total	$7,000 00

All of which is respectfully submitted.

S. R. THROCKMORTON,
B. B. REDDING,
J. D. FARWELL,
Commissioners.

APPENDIX.

COMMISSIONERS ON FISHERIES.

UNITED STATES.

Professor Spencer F. Baird	Washington, D. C.

MAINE.

E. M. Stillwell	Bangor.
Henry O. Stanley	Dixfield.

NEW HAMPSHIRE.

Thomas E. Hatch	Keen.
William W. Fletcher	Concord.
W. A. Sanborn	Wiers.

VERMONT.

M. C. Edmunds	Weston.
M. Goldsmith	Rutland.

MASSACHUSETTS.

Theodore Lyman	Brookline.
E. A. Brackett	Winchester.
Asa French	South Braintree.

CONNECTICUT.

William M. Hudson	Hartford.
Robert G. Pike	Middletown.
James A. Bill	Lyme.

RHODE ISLAND.

Newton Dexter	Providence.
Alfred A. Reed, Jr	Providence.
John H. Barden	Scituate.

NEW YORK.

Horatio Seymour	Utica.
Robert B. Roosevelt	New York City.
Edward M. Smith	Rochester.

NEW JERSEY.

R. P. Howell	Woodbury.
J. H. Slack	Bloomsbury.

PENNSYLVANIA.

H. J. Reeder	Easton.
B. L. Hewitt	Holidaysburg.
James Duffy	Marietta.

VIRGINIA.

William B. Ball	Mid Lothian.
Asa Wall	Winchester.

ALABAMA.

Charles S. G. Doster	Montgomery.
Ro. Tyler	Montgomery.
D. R. Hundley	Courtland.

CALIFORNIA.

B. B. Redding	Sacramento.
S. R. Throckmorton	San Francisco.
J. D. Farwell	San Francisco.

MICHIGAN.

Governor J. J. Bagley	Detroit.
George H. Jerome	Niles.
George Clark	Ecorse.

OHIO.

John Hussey	Loveland.
John H. Klippart	Columbus.
Dr. Elisha T. Stirling	Cleaveland.

REPORT

OF THE

COMMISSIONERS OF FISHERIES

OF THE

STATE OF CALIFORNIA,

FOR

THE YEARS 1874 AND 1875.

7946

G. H. SPRINGER.........STATE PRINTER.

REPORT.

To His Excellency,
Romualdo Pacheco,
Governor of California:

The Commissioners of Fisheries for the State of California, appointed under an Act of the Legislature entitled "An Act to provide for the restoration and preservation of fish in the waters of this State," approved April second, eighteen hundred and seventy, respectfully submit their Third Biennial Report.

REPORT.

Your Commissioners detailed in their last biennial report the loss of the aquarium car, in eighteen hundred and seventy-three, by the breaking of a railroad bridge over the Elkhorn River, in Nebraska, by which one year's time was lost in the experiment of stocking the waters of California with new varieties of valuable food-fish.

In eighteen hundred and seventy-four we determined again to repeat the experiment, believing, that if successful, it would in time largely repay the people of the State for the small amount expended. We, therefore, in March, eighteen hundred and seventy-four, telegraphed to Mr. Livingston Stone to prepare another aquarium car, and by letter instructed him with reference to the varieties of fish to be brought across the continent. He arrived on June twelfth, having succeeded in transporting the following fish:

Seventy-three full grown spawning Black Bass from Lake Champlain, which were placed in Napa Creek.

Twelve small Black Bass (*Grystes fasciatus*), from St. Joseph's River, Michigan, which were placed—a portion in Napa Creek, and a portion in Alameda Creek.

Sixteen full grown Glass-eyed Perch (*Lucio perca*), from Missisquoi River, Vermont, which were placed in the Sacramento River, opposite Sacramento City.

Seventy-four Catfish—fifty-six being the large Schuylkill Catfish obtained in the Raritan River, New Jersey, and the remainder, Mississippi Catfish, from Elkhorn River, Nebraska, which were placed in the San Joaquin River, near Stockton.

Seventy Horn-pouts (*Pimelodus*), from Lake Champlain, Vermont, which were deposited in lakes at Sutterville, Sacramento County.

One can—containing twelve—small Silver Eels (*Anguilla*), from Hudson River, New York, which were placed in a lake near Sacramento.

Three hundred and five small Eastern Salmon (*Salmo salar*), which were obtained from the Penobscot River, Maine, and were deposited in the Sacramento River, near Redding.

Four full grown Rock Bass from the Missisquoi River, Vermont, which were deposited in Napa Creek.

Of salt-water fish there arrived twenty-three Tautogs or Black Fish (*Tautoga Americana*), from Woods' Hole, Massachusetts, which were deposited in the Bay of San Francisco.

Of the one hundred and fifty full grown spawning Lobsters, with which Mr. Stone started, and which were obtained in the Bay of Massachusetts, but three arrived alive. These were placed in the Bay of San Francisco.

One can of small salt-water Eels, about one thousand five hundred, obtained in New York harbor, were deposited in the Bay of San Francisco, opposite Brooklyn.

The details of Mr. Stone's experiments, in gathering and transporting these different varieties of fish on so long a journey, will be found appended to this report, and are a valuable contribution to the new science of fish culture, and will enable the Commissioners of other States to take advantage of Mr. Stone's experiments in the transportation of live fish during long journeys.

Of the new varieties of fish thus introduced into the waters of California, we are satisfied that the greater number have found congenial homes, and have spawned. Black Bass have, during the present season, been caught in Napa Creek, and large numbers of the young have been seen. By another season they could be obtained in limited quantities for the purpose of stocking ponds and streams in other portions of the State, by such persons as desire them. They should only be placed, however, in streams and ponds not adapted to Trout, for the reason that if placed in Trout streams they destroy the Trout. The Black Bass placed in Alameda Creek have been seen, but so far as we can learn, none have been caught. One of the Glass-eyed Perch placed in the Sacramento River has been caught in a slough, to which it was probably repairing for the purpose of spawning. No report has come to us that any of the young have yet been seen.

The Schuylkill Catfish and the Mississippi Catfish, placed in the San Joaquin River, have grown rapidly and spawned, but several of the large fish, and many of the young ones, have been caught by the fishermen near the San Joaquin bridge, and have been returned to the river. The fishermen at that point are much interested in their successful cultivation, and seem desirous that they should be preserved. By another year they will be so numerous that they may be caught with safety and shipped to market, as it would be impossible to exhaust the river by ordinary fishing. The Horn-pouts, a species of small Catfish from Lake Champlain, which were placed in the lakes near Sacramento, have increased so abundantly that nearly one thousand have been caught and transported to the various lakes and sloughs in the Sacramento Valley. We caused several hundred of them to be placed in lakes containing brush and dead trees, in which it would be impossible to seine them. The acclimatization and perpetuation of these fish in the Sacramento Valley is assured, as they are now so situated that no amount of fishing will exhaust them.

Of the fresh-water Eels placed in a tributary of the Sacramento River, we learn that one had been caught in Willow Slough, in Yolo County, which had grown to be more than a foot in length.

None of the Eastern Salmon have been seen since they were placed in the Sacramento River. It is hardly to be expected that they should be, as yet, as without doubt they have gone to the ocean, not to return until the Spring of eighteen hundred and seventy-six, when we hope to hear of some of them being caught on their return for the purpose of spawning. It will be interesting to learn, in after years, if they will cross with the Sacramento Salmon and produce a new variety.

The Rock Bass, placed in Napa Creek, we have not heard from.

We have no knowledge that the Tautogs, salt-water Eels, and spawning Lobsters, placed in San Francisco Bay, have ever been seen. Many crustaceans, resembling young Lobsters, have, during the present season, been caught in the Bay of San Francisco, which were not before known. It is not yet definitely determined that these are the young of the Lobsters brought from the East.

We feel that this experiment in the importation of new varieties of fish is so great a success that the people of the State are already amply repaid for the small amount of money expended in the undertaking.

WHITE FISH.

During the past Winter we received from the United States Government, through the kindness of Professor Spencer F. Baird, United States Fish Commissioner, twenty thousand White Fish eggs from Lake Michigan (*Coregonus alba*). We also purchased, in Charlestown, N. H., sixty thousand eggs of the Eastern Brook Trout. It will be remembered that in eighteen hundred and seventy-three, we received from the Government of the United States twenty-five thousand White Fish eggs from Lake Superior, which were successfully hatched at Clear Lake, and placed in that body of water. Inasmuch as Clear Lake seemed to be well stocked with these fish—several mature fish having been caught during the past Winter—we thought it advisable, if successful in hatching, to place this donation in Tulare Lake; the inhabitants of that vicinity very much desiring it, and the waters of that lake being of the proper temperature and containing their natural food. We, therefore, through the kindness of the Regents of the University, were permitted to erect a small hatching-house on the banks of the stream at Berkeley, where, under the supervision of Mr. J. G. Woodbury, these eggs were successfully hatched. This point was selected because the building erected on the University grounds, when not in use for hatching purposes, would be under the supervision of the officers of the University, and it seemed of importance that the students should have an opportunity, if they so desired, to learn practically the process of fish-hatching. On the twenty-ninth of March, eighteen hundred and seventy-five, the young fish were placed in Tulare Lake, which is the largest body of fresh water in the State, and, we have no doubt, that in a few years it will be abundantly stocked with this most valuable variety of food-fish. Experiments made by filling a vessel with water from the lake, and placing some of the young fish in it, showed that the water is filled with the minute vegetable matter and animalcula on which the young fish feed, as they immediately commenced darting in every direction in search of food. We carried the cans of young fish in a boat some two hundred yards from the shore, and turned them into the lake among large patches of tule where they can hide from their natural enemies. The lake contains, at the present time, but two varieties of fish that are used for food—a Perch, and a large cyprinoid, locally called Lake Trout, and, if these experiments of planting in it White Fish shall prove a success, it will give the people of the San Joaquin Valley an abundance of most excellent fish.

TROUT.

The sixty thousand eggs of the Eastern Brook Trout were also hatched at the State hatching-house, at Berkeley, under the supervision of Mr. Woodbury, with a loss of only four per cent, which were distributed in the public waters of the State, as follows:

Twenty thousand in the lakes and streams of Mendocino, Sonoma, Napa, and Yolo Counties.

Ten thousand in the North Fork of the American River, in Placer County.

Ten thousand in Prosser Creek, in Nevada County, and twenty thousand in Calaveras Creek, in Alameda and Santa Clara Counties, and in other streams emptying in the Bay of San Francisco.

SHAD.

We were unable to procure from the United States Government any young shad during the past two years. The hatching of them by the Government was not so successful as heretofore, and all that were hatched were required to be turned into the rivers running into the Atlantic. California is promised a large supply if the Government is successful in hatching during the next year. Of the fifty thousand that have been heretofore planted in the Sacramento River, in eighteen hundred and seventy-one, and eighteen hundred and seventy-three, by Seth Green and Livingston Stone, we know that many of the first have returned from the ocean, and, without doubt, have spawned. The last lot of thirty-five thousand will certainly return from the ocean in February and March next for the same purpose. We believe that these experiments of transplanting Shad to the rivers of the Pacific Coast, will prove a success. We know of some sixteen full-grown Shad having been caught at Vallejo and in the Sacramento River, and have heard reports of others having been taken during the present season; but, as under an Act of the Legislature, every person who takes a Shad prior to March, eighteen hundred and seventy-seven, is subject to a penalty of fifty dollars, we find it difficult to obtain information in relation to the catching of Shad, until after the evidence has disappeared.

We believe that after eighteen hundred and seventy-seven, Shad will be found quite numerous in the Sacramento River.

SALMON.

The largest establishment in the world, for the hatching of salmon eggs, is that of the Government of the United States, on the McCloud River, in Shasta County, under the superintendence of Mr. Livingston Stone. At this point from six to ten million of young Salmon are hatched each year and distributed to the Fish Commissioners of the various States having rivers suitable for their growth and increase. In eighteen hundred and seventy-three California received from this source half a million fish, which were turned into the Sacramento River. The Government works at this point are so extensive, and conducted with such economy, that it is found that the total cost of hatching one thousand fish from the egg is but one dollar.

We have thought it to be of so much public importance to increase this valuable variety of fish in its native waters, that during the past year we considered it advisable to expend one thousand dollars in the hatching of a million more fish, to be placed in the Sacramento River. We therefore applied one thousand dollars of our small appropriation to this purpose, and the fish have been successfully turned loose.

Our appropriation being about exhausted, we will this year pay for the hatching of but half a million more fish.

The importance of the object of increasing the quantity of Salmon in the Sacramento River for the public benefit has, however, attracted the attention of some of our public-spirited and wealthy citizens, who are actuated by a desire to increase the food supply of valuable fish. Ex-Governor Leland Stanford has requested your Commissioners to cause to be hatched during the present season (at his expense) one million Salmon, to be turned into the Sacramento River; and Mr. Charles Crocker has also requested your Commissioners to hatch (at his expense) half a million more; some hundred thousands, at his desire, have been placed in Kern River and in Lake Tahoe.

There will, therefore, be placed in the waters of this State, during the present season, and before this report is printed, two million of Salmon; and should the State receive her usual share from the Government, probably half a million more.

We have every reason to believe that the Salmon donated by Mr. Crocker to the public, and turned into Kern River and Lake Tahoe, will thrive and increase, and add largely to the valuable food-fish for the inhabitants of those portions of the State. It seems to be pretty well settled, from experiments made by the Commissioners in other States, that it is not absolutely necessary for Salmon to go to the ocean; if they can reach large bodies of water, containing an abundant supply of food, their purpose is answered, whether the water is fresh or salt. It is reported, on good authority, that the young Salmon, placed a few years since in the rivers of Michigan, found sufficient food in the waters of the lakes, and, during the past year, returned to the rivers in which they were placed and deposited their spawn. The waters of Lake Tahoe empty into Pyramid Lake, whose waters are brackish, and abundantly supplied with food. Kern River empties into Kern and Buena Vista Lakes, whose waters are slightly alkaline and brackish.

It is hoped that these fish may find these waters suitable for their purpose, for should the experiment be attended with success, it will add materially to the wealth of the State.

Salmon have been more plentiful in the Sacramento River, during the present season of eighteen hundred and seventy-five, than ever before, since Americans had knowledge of the country. This is to be attributed, first, to the "close season," under an Act of the Legislature, which prohibits the catching of Salmon anywhere in the State between the first of August and the first of November; and, secondly, to the quantities of young Salmon turned loose from the artificial hatching establishment, which were donated to the State by the Government of the United States. Whether or not Mr. Crocker's experiment, of placing Salmon in rivers having no outlet to the ocean, shall result in success, it is certain that the million of Salmon, artificially hatched and turned, during the present season, into the Sacramento River, at the expense of ex-Governor Leland Stanford, added to those hatched from the State appropriation, and those donated by the United States Government, will so materially increase the quantity of these fish in that river that, after three years, there will be found more profitable fishing than has heretofore been known.

We believe that if the Legislature, instead of giving to the control of your Commissioners a mere pittance of two thousand five hundred dollars a year, for the purpose of the importation of new varieties of fish and increasing the quantities of native fish, were to make an appropriation of six or ten thousand dollars yearly, that so many Salmon could be hatched and deposited in the Sacramento and San Joaquin Rivers that, after three years, the fish would be so numerous that they would compel as extensive Salmon canning establishments on those rivers as there are now on the Columbia, and that the increase of wealth and revenues to the State, from these sources, would pay one hundred fold on the outlay.

In this connection, we desire to call attention to Mr. Livingston Stone's report to the Commissioners, hereto appended, on the subject of the Salmon of the Sacramento, and of the increase of wealth that may be derived from this source.

While on the subject of the necessity for increasing the appropriations, your Commissioners may also be pardoned in alluding to the fact that all of the business, in connection with the Fish Commission, is attended to without salary, and that, in the necessary work of receiving and distributing fish, they pay their own traveling expenses. They would, therefore, confidently ask the Legislature for this increase, which, without abatement, would be applied to the objects of the appropriation, in increasing the variety and quantity of food-fish in our rivers, lakes, and bays.

Much attention is given to the Sacramento Salmon (*Salmo quinnat*) by scientists and by fish culturists in other countries, for the reason that it comes into rivers to spawn in latitudes much lower and in waters much warmer than any other variety yet known. Large numbers pass up the San Joaquin River for the purpose of spawning in July and August, swimming for one hundred and fifty miles through the hottest valley in the State, where the temperature of the air at noon is rarely less than eighty degrees, and often as high as one hundred and five degrees Fahrenheit, and where the average temperature of the river, at the bottom, is seventy-nine degrees, and at the surface, eighty degrees. The Salmon of the San Joaquin River appear to be of the same variety as those in the Sacramento, but average smaller in size. Their passage to their spawning grounds at this season of the year, at so high a temperature of both air and water, would indicate that they will thrive in all the rivers of the Southern States, whose waters take their rise in mountainous or hilly regions, and, in a few years, without doubt, the San Joaquin Salmon will be transplanted to all of those States. The fact that the San Joaquin Salmon should be found in a river in one of the warmest portions of California, at the hottest season of the year, for this purpose, is so extraordinary, that we here append the maximum, minimum, and mean temperature of the air and water for the months of August and September, from the record kept at the railroad bridges crossing this river. These statements will be of great service towards determining the fact into what Southern rivers, emptying into the Gulf of Mexico and the Atlantic Ocean, the San Joaquin Salmon may be safely transplanted.

TEMPERATURE.

Lower crossing San Joaquin River, months of August and September, eighteen hundred and seventy-five. Latitude 37° 50′ N. *Longitude* 121° 22′ W.

		Air.	Water at surface.	Water at bottom.
		Degrees.	Degrees.	Degrees.
August	Maximum.....	98	82	81
August	Minimum......	73	72	71
August	Mean	$88\frac{16}{100}$	$78\frac{67}{100}$	$78\frac{3}{100}$
September...	Maximum.....	94	78	78
September...	Minimum	73	72	72
September...	Mean	$85\frac{63}{100}$	$74\frac{8}{100}$	$74\frac{43}{100}$

Upper crossing San Joaquin River. Latitude 36° 52′ *N. Longitude* 119° 54′ *W.*

		Air.	Water at surface.	Water at bottom.
		Degrees.	Degrees.	Degrees.
August	Maximum.....	107	84	83
August	Minimum......	82	74	73
August	Mean	$100\frac{61}{100}$	$80\frac{67}{100}$	$79\frac{67}{100}$
September...	Maximum.....	104	82	83
September...	Minimum......	82	74	73
September...	Mean	$95\frac{53}{100}$	$78\frac{83}{100}$	$77\frac{83}{100}$

We have obtained, through the courtesy of the officers of the Central Pacific Railroad Company, the following statistics of the Salmon shipped over their lines, from various points on the Sacramento and San Joaquin Rivers, from November first, eighteen hundred and seventy-four, to August first, eighteen hundred and seventy-five, this being the only portion of the year in which Salmon are, under the law, allowed to be caught:

From Collinsville, New York of Pacific, Rio Vista, Emmaton, Jersey Landing, Antioch, Benicia, Courtland, Martinez, Kentucky, Bradford, Sacramento, Vallejo, and Webbs.	To San Francisco, from Nov. 1, 1874, to August 1, 1875	128,692 loose salmon, weighing	3,217,300 lbs.
		1,874 boxes of salmon, weighing..................................	421,650 lbs.
		1,847 sacks and baskets of salmon, weighing........................	184,700 lbs.
		116 barrels cured salmon, weighing	23,100 lbs.
		225 barrels and boxes smoked and dried salmon, weighing	45,000 lbs.
From Courtland, Benicia, Rio Vista, Emmaton, and Collinsville...	To Sacramento, from N'v 1, 1874, to Aug. 1, 1875	1,733 loose salmon, weighing...	43,325 lbs.
		722 boxes of salmon, weighing	83,700 lbs.
		117 baskets and sacks of salmon, weighing........................	11,700 lbs.
		212 barrels of salmon, weighing	29,900 lbs.
From Antioch................	To Stockton, from Nov. 1, 1874, to Aug. 1, 1875........	96 loose salmon, weighing.......	2,400 lbs.
		73 boxes of salmon, weighing..	16,250 lbs.
Total...			4,079,025 lbs.

The above statistics only include the Salmon carried from the Sacramento and San Joaquin Rivers, to the Cities of San Francisco, Sacramento, and Stockton, from points below the Cities of Sacramento and Stockton; they do not include the catch of the fisheries at Tehama and the upper Sacramento River, etc., nor of the upper San Joaquin. Neither do they include Salmon brought to market by other conveyances than by the cars and steamers of the Central Pacific Railroad Company, nor those caught and sold during the "close" season. It is, therefore, safe to add one fourth to the above total. This would give, as the total weight of Salmon caught during the past season, in the Sacramento and San Joaquin Rivers, five million ninety-eight thousand seven hundred and eighty-one pounds, which, at the average wholesale price, would make the business yield, annually, a half million dollars.

(There were shipped by rail from Sacramento to Chicago and New York, during the same period, ninety-two thousand pounds of fresh Salmon in ice. These have not been added to the total of the foregoing statistics, for the reason that they may have been included in the schedule of those forwarded to Sacramento, from points on the river below that city.)

From the same points, by the same conveyances, there were shipped to San Francisco two thousand three hundred and sixty-seven Sturgeon, weighing one hundred and eighteen thousand three hundred and fifty pounds.

CARP.

We have received information from United States Fish Commissioner Spencer F. Baird, that he is expending a portion of the appropriation made by the Government in the importation of the European Carp, and especially of the "King" Carp, from the regions of the Upper Rhine, the Danube, and the Po. Some of these fish have arrived and have been placed in ponds near Baltimore. We are promised a portion of the increase of these fish for distribution in the waters of this State.

Some Carp, from Hamburg, which were imported a few years since by Mr. Poppe, of Sonoma, and planted in ponds of that county, have thrived, and the produce is occasionally sold in the San Francisco market. These fish are, of course, private property.

It is the opinion of those best acquainted with the subject that there is no fish that promises so great a return in limited waters. It is eminently adapted to the sloughs, tule lakes, and inland waters of the Sacramento and San Joaquin Valleys. It has an advantage over the Black Bass and Trout, in that it is a vegetable feeder, and, although it will not refuse animal food, it can thrive well on aquatic vegetation alone. On this account it can be kept in tanks and small ponds, and a larger weight obtained without expense than in the case of the other kinds mentioned.

Professor Baird, in his annual report, says: "It is a mistake to compare the flesh of the Carp with that of the ordinary *cyprinidæ* of the United States, such as Suckers, Chub, and the like; the flesh of the genuine Carp being firm, flaky, and in some varieties almost equal to the Trout."

LOBSTERS.

Whether the few Lobsters brought in the aquarium car, and placed in the Bay of San Francisco, have lived and cast their eggs which have produced young, is uncertain. Nothing but scientific investigation by persons familiar with the young of various kinds of crustaceans, will decide whether the so-called young Lobsters which have made their appearance in the Bay of San Francisco, during the present season, are in reality Lobsters. Great interest appears to be felt in the introduction of this variety of shell-fish to the Pacific Coast.

Should the Legislature see fit to increase the appropriation, we will again make the attempt to plant Lobsters in the waters of California. In furtherance of this project, Professor Baird has been making various experiments at Woods' Hole, Massachusetts, during the present Summer, for the purpose of ascertaining by what mode Lobsters can longest be kept alive. When the results of these experiments have been demonstrated, we will again make the attempt.

SEA LIONS AND SEALS.

For many years the Sea Lions and Seals which inhabit the cliffs near the entrance to the Bay of San Francisco, have been preserved by special enactment, and penalties imposed on any person who should kill or disturb them. The result is, that they are probably now a hundred times as numerous as they were ten years since, and are to be found there in thousands. When it is considered that they weigh from two to five hundred pounds each, and that they each consume at least from ten to twenty pounds of fish daily, it will be readily seen that the quantity caught at the entrance of the harbor and in the Bay of San Francisco, by fishermen, is small in proportion to that consumed by these animals. If allowed to increase at the same rate for a few more years, it will be difficult for either Shad or Salmon to escape them, while entering our bay. The fishermen at Vallejo and Rio Vista report that they find many of the Salmon to have been torn by the teeth of these animals. They appear now to serve no useful purpose, other than to gratify the curiosity of strangers, and we believe it would be well if the law which now protects them were repealed, and nine tenths of them were allowed to be shot, that their oil might be utilized in the lubrication of machinery. We would recommend that this law be repealed, and, if necessary, again reënacted after nine tenths of them had been destroyed.

OVER-FISHING.

The preservation of the fish in the waters of this State is of so much importance that we would advise the appointment of a standing committee by the Legislature, on the subject of the fish and fisheries of California. This committee should take testimony in relation to the different modes of catching fish by nets, traps, etc., and, after information had been obtained, advise as to the size of the mesh of gill nets, and if any of the present modes of fishing should be restrained or regulated. It has come to the knowledge of your Commissioners that the Chinese, for catching Shrimp (which are dried and exported to China), use a net of a mesh so small that hardly any of the young of the valuable varieties of our fish escape; and, when it is remembered that the majority of the young of the salt-water fish of the coast seek their food in the shallow waters near the shore, where the stake-nets for Shrimp are placed, and that all of the young fish thus caught are either thrown on the shore to die, or fed to hogs, it is evident that without legislation many varieties of our fish will soon be exhausted. A great many tons of dried Shrimp are annually shipped to China by the Chinese merchants of San Francisco. There must be several hundred Chinese fishermen engaged in fishing for Shrimp in the Bay of San Francisco, for that market. When it is remembered that many of our most valuable varieties of sea fish come into the bay seeking for Shrimp as their natural food, it is a question whether unrestrained and unregulated fishing for this crustacean will not, in time, seriously affect the fisheries of the bay and harbor.

Under the law, as it at present exists, in relation to Trout, Indians are unrestrained in their mode of catching them. Taking advantage of this, white men, for purposes of gain, employ Indians to catch Trout from the various mountain streams with grab-hooks, baskets, and all the other methods which ingenuity has devised for the trapping and catching of fish, without regard to the season. Legislation should be had to prevent the Indians from taking fish, except in the manner to which they were accustomed before the advent of white men.

FISHWAYS.

We have adopted a plan for a fish ladder, and caused the same to be lithographed, and distributed copies to all persons who were erecting dams on streams containing fish. Those that have been erected work satisfactorily, and we continue to furnish plans to all who may ask them. So far, we believe, all parties who have been notified to construct fishways have done so.

OBSERVANCE OF THE FISH LAWS.

The duties of your Commissioners involve a vast amount of correspondence—especially with people who see some violation of the laws for the preservation of fish. We desire to call attention to the fact that it is not, especially, the duty of the Fish Commissioners to see the laws observed, but it is also the duty of every citizen; and if, when persons see a violation of the law, they will notify the District Attorney of the county, giving him the information and the facts, and informing him where the witnesses can be found, he will prosecute without waiting for a request from the Commissioners.

SAWDUST.

At one time Salmon were quite numerous in the American, Yuba, and Feather Rivers. In eighteen hundred and fifty and eighteen hundred and fifty one, large quantities were taken by the miners and by Indians at Salmon Falls, on the American River, as far up as Downieville on the Yuba, and at various points on the Feather River. No Salmon visit these streams at the present time. This is not because of the earthy matter from mining held in suspension in the water of these rivers, for the Salmon pass readily through the lower part of the Sacramento River, which is as muddy as any of these streams, but because the deposit from mining covered the gravel beds where the fish spawn. It seems to be necessary for Salmon eggs to mature and hatch out the young fish, that they should be deposited in beds of clean gravel over which pure water is passing.

The Salmon readily go through muddy water to reach their spawning beds, but there must be no mud or sediment where their eggs are laid. The Salmon certainly passed up these streams for a few years after extensive mining was prosecuted, but their spawning beds being covered by sediment, their eggs would not mature; and as the old fish died or were killed (no new ones taking their place), they became extinct in these streams. A similar condition of things exists with regard to sawdust; neither Salmon nor Trout object to passing through water in which sawdust is floating, and if their spawning beds are above the sawmills, the fish in the streams on which sawmills are situated will continue to breed; but if the sawmills are situated above the spawning beds of the fish, the sawdust is deposited on their beds, and the fish in a few years become extinct.

In Canada and other of the British Provinces where there are extensive lumber interests, by provision of law each sawmill is required to have a furnace attached, in which the sawdust as fast as made is consumed. The expense of such a furnace is but trifling, and in those countries the fish is preserved and the law obeyed without objection. We would recommend that a similar law be enacted in this State, and, while great objection is made to it on the part of mill owners, yet, probably, the millmen on the Truckee River and its tributaries have already expended more money in the publication of pamphlets, and in other means to defeat legislation on this subject, than would be sufficient to build furnaces for all the mills on that river.

TRANSPORTATION OF SALT–WATER FISH.

We are frequently asked to expend a portion of the appropriation in bringing to this coast some of the salt-water fish of the Atlantic. As will be noticed from Mr. Stone's report, the only salt-water fish which he succeeded in bringing through alive were Tautog. The truth is, that the science of fish culture is so young that the preservation alive, and the transportation of salt-water fish is, as yet, entirely experimental, and our appropriation is so small that we have not felt authorized to expend any portion of the money in doing California's share in ascertaining how best salt-water fish may be successfully transported. For two seasons past the Governments of the United States and Germany, with the benefit of all the knowledge and intelligence yet acquired, have been unable to successfully transport young Shad from the Hudson to the rivers of Germany emptying into the Northern Ocean. Professor Baird has during the present Summer been expending a portion of the Government appropriation in determining how long various salt-water fish, including Lobsters and other shell-fish, can be kept alive in small bodies of sea water. When the result of these experiments is ascertained, if found practicable, it would be of much advantage to import several of the fish of the Atlantic coast, as well as the Chinese Shad (called by them *Samlai*) from the Yang-tze Kiang River, which is said to be much larger and of finer flavor than the Shad of the Atlantic coast; also, the Gourami, a large fresh-water fish from Cochin China, which is very valuable for food, and living, as it does, on aquatic plants, would thrive in the sloughs and stagnant waters in the southern portion of the State.

In conclusion, we desire again to call attention to the valuable reports of Mr. Stone hereto appended, as giving information valuable for preservation, and to again ask through you of the Legislature an increased appropriation for the purposes of the Commission. We may be permitted to refer (without laying ourselves open to the charge of egotism) to what has already been accomplished during our tenure of office with the very limited appropriation at our command.

The observations we have made upon the food fish of our rivers, and the statistics we have gathered from various sources for the information of those who are interested in the science of fish culture, have involved a large amount of labor which, on the part of your Commissioners, has been altogether gratuitous. A liberal appropriation by the Legislature will enable us to extend our operations and carry out to completion the objects for which this Commission was created. We feel that the work we are engaged in, and in the promotion of which we are willing to devote our time and labor in the future, is deserving of a more liberal support from the State than it has hitherto received.

SACRAMENTO SALMON.

United States Fish Commission,
Department of the Pacific Coast,
McCloud River (Shasta County, Cal.), September, 1875.

S. R. Throckmorton, Esq., *Chairman of California Fish Commission, San Francisco:*

Sir: I beg leave to report as follows:

In the Summer of eighteen hundred and seventy-four, an agreement was entered into between the California Fish Commission and myself, with the approval of the Hon. Spencer F. Baird, United States Commissioner of Fish and Fisheries, to the effect that, in consideration of the payment of one thousand dollars by the California Commissioners, towards defraying the expenses of the United States Salmon-breeding establishment on the McCloud River, California, one million young Salmon should be hatched and placed in the McCloud River by the United States Fish Commission.

In pursuance of this agreement, a large number of young Salmon were hatched on the McCloud River last Fall, for the purpose above mentioned, and eight hundred and fifty thousand were placed in the river in fine condition, during the months of October and November, and the balance—one hundred and fifty thousand—are now in process of being hatched, and will be deposited in the river this Fall.

In presenting the report of these operations in Salmon breeding, it may not be out of place, perhaps, to say a few words concerning fish culture in general, and the increase of Salmon in the Sacramento River in particular.

The preservation or increase of any of the original sources of the food supply of the human race would, from its inherent character, be naturally a subject of universal interest. This has proved to be eminently true of the efforts which have been made in various countries with a view to the preservation and increase of the food fishes of the world. The single circumstance that all the world eats fish, has commended the culture of fish to the sympathies of almost every one, and would alone sustain an interest in anything that is done to secure or augment the supply. But the cultivation of fish, besides its general recommendation to the world's attention, has additional and special points of interest—such, for instance, as its novelty, and the very peculiar character of its methods of operation. But chief among its special claims is the promise of its vast returns. Nowhere above the domains of insect and vegetable life is found the vast possible increase from generation to generation that exists in the culture of fish. For a good illustration of the possibilities in this direction, we might take the case of the Sturgeon, which is said to deposit three million eggs each season. Supposing that the embryo in all these eggs should hatch out and mature into full-grown fish, and that each pair of these, when matured, should produce a similar number of offspring, what would be the result? It would be, that in two generations forty-five hundred thousand million Sturgeon would be brought into the world, or enough fish, when grown to an average size and placed lengthwise in a line, to reach one hundred and fifty thousand times around the world, or, with an average weight of one hundred pounds apiece, to make two hundred and twenty-five thousand million tons of fish. This, of course, is merely a conceivable, and, very fortunately, not a practicable example, but it strikingly illustrates the almost fabulous rate of possible increase in the generation of fishes.

It is this feature of it which forms one of the special merits of fish culture, and one of its strongest claims to public attention and support. A consideration, hardly less forcible in its favor, is the circumstance that the growth and increase of the fish cost the community nothing after they are once fairly introduced into suitable waters. Legislatures are not obliged to pass appropriations to provide food for the fish, or inclosures within which to confine them. After a river or lake is once properly stocked with a valuable variety of fish, then all expense ceases. The fish have natural inclosures. Nature supplies their food, and man is relieved from any further trouble about them. This very simple fact, that the fishes cause no expense or trouble to the community, has an importance which is not generally recognized. To bring this out more fully, I will present one illustrious example—the Salmon of the Columbia River. The annual Salmon yield of this river, as is well known, is enormous. In eighteen hundred and seventy-four there were put up and exported from the Columbia River, upwards of twenty million pounds of canned Salmon. We will say that half as much more was cured or eaten fresh. This makes a total of thirty million pounds of fish-food furnished by one river alone. Now, the whole thirty million pounds of food has not cost the community a single dollar for its raising or keeping. Rating the Salmon at an average price of twenty cents a pound, we have six million dollars worth of food produced without the cost of a dollar to mankind, either for rent of grounds, for inclosures, for care, or for food. The subsistence required to sustain this enormous amount of fish does not even make any diminution whatever of the resources of the community. They get their food entirely in the sea, where it costs no one anything, and where it is not even missed.

This instance illustrates, in a striking way, what is true of all varieties of fishes, and brings out a point in fish culture the value of which can be hardly overestimated. The Fish Commissioners, when they give the community living fishes in return for their appropriations, give them once for all, and pay the bills once for all. The fish become at once a portion of the public property, in regard to which all expenditures are at an end. The community will not have to feed the fish, or take care of them, or do anything more about it, except to take out the fish as they are wanted. Even if the efforts of the Fish Commissioners, in many instances, are failures, it will cost the State or country nothing beyond the first outlay, which in most cases is comparatively very small indeed.

To these two facts just mentioned, of the marvelous increase of fishes, and the absence of any cost in the keeping and growing of them, should be added a third, in order that the merits of fish culture should be fully brought out. This third fact is the one just alluded to, viz: the very slight comparative extent of the original outlay. Two or three thousand dollars, for instance, will place twenty million young Shad in the Hudson or Connecticut Rivers. A thousand dollars will place a million Salmon in the Sacramento River. Millions of White Fish—not the White Fish of California, but the very valuable "*Coregonus Albus*," of Lake Superior—can be hatched at an expense of not many hundreds of dollars. I saw, this Spring, some handsome young Salmon, of about two pounds each, that were caught with a hook and line in Merced Lake—as fine looking fish as I ever saw. Two hundred dollars, expended by the State, will put one hundred thousand of these fish into any lake of California. These instances are, perhaps, sufficient to show how small is the original outlay, in fish culture, compared with the returns. Now, if these three facts are taken into consideration, viz: the marvelous annual increase of fishes, the absence of any cost of keeping and growing, and the insignificant character of the original expenditure, it will be seen that the cultivation of fishes promises advantages that eminently commend it to the public approval.

If, in answer to this last statement, it should be objected that the Fish Commissioners do not make a success of all their enterprises, a simple reply may be found in the fact that when they do succeed, it more than offsets all their failures. They can afford to fail a great many times if they make a success at last, for that success will pay over and over again for all that the failures cost. For example, the United States Fish Commission is introducing California Salmon into many places in the Eastern States, where they will, undoubtedly, be a total failure, but should the Commission make a success of a single river of the size, or half the size of the Sacramento, it would pay for all that has been expended in this direction on all the other waters of the United States. To come a little nearer home, let us see what bearing the foregoing remarks have upon the work of the California Fish Commission. Their appropriation for this year and last, has been two thousand five hundred dollars a year. With this small sum, they have introduced various kinds of Eastern fish, including among others, Lobsters and Shad, into California waters, and have added a million Salmon to the stock of the Sacramento River, besides distributing many thousand Eastern Trout throughout the State. Now I do not suppose that every branch of these enterprises has been a success, but I venture to say that if Lobsters alone were successfully planted on this coast, or if Shad were introduced with success into the Sacramento River, the returns to this State from either enterprise would be such that the paltry outlay of two thousand five hundred dollars a year would sink into insignificance in comparison. If everything the Commission undertakes is a failure, even then the loss has not been much, and the risk has been more than justified by the brilliant character of the promised results, and if one considerable success is achieved, it will more than compensate for all losses.

In this connection it may be mentioned that the people are in great danger of being misled on this point, by inferring that the work of any specified Commission is a failure because it has failed in some insignificant locality that they are familiar with, while, perhaps, this was one case out of twenty, the other nineteen of which had been successful. Then, again, what the public in many cases considers a failure, is not by any means a failure in point of fact, but the successful trial of an experiment, although, perhaps, it has failed to produce practical results, the object of the effort having merely been to acquire information. In such cases, if the information is obtained the effort is equally a success, whether in practical results it fails or succeeds. For example, the California Fish Commission wants to ascertain whether a specified variety of fish will live in water like that of Tulare Lake. The fish are accordingly introduced there. They do not thrive, we will suppose. The neighboring inhabitants immediately set the thing down as a failure, while in point of fact the experiment has been an entire success—the Commissioners having acquired the information which was the object of the undertaking.

Leaving this point, let us consider a special objection that has been made to the efforts of the Fish Commission of this State. The objection I refer to is that which some people put forward because they do not like *all* the varieties that have been brought here from the East. Some object because they do not care anything about Horn-pouts; others object because they do not like Eels; others because they do not like Catfish, and so on. But what is it that ought to govern the character of an enterprise of this sort? Certainly not the peculiar tastes of some individuals. The wishes of all should be met if possible, and if some like Shad, they ought to have Shad; if some like Catfish, they ought to have Catfish, and so on with the rest—Bass, Eels, Lobsters, and so forth—as a caterer preparing a dinner for a large number of people places on the table all kinds of dishes, so that all may find something that they like. I have heard individuals abuse the Fish Commission for introducing (as they said) such an insufferable fish as the Catfish into California, as if their individual tastes on this point should be the guide of the Commission. How foolish the objection was may be seen from the fact that I have had more requests from persons in this State for Catfish than for any other variety. The fact is, that a fish that is highly valued in one locality frequently has a poor reputation in another, and it often happens that a certain variety of fish is of fine quality in some waters and a very poor fish in others; as, for instance, the very Catfish of which we have been speaking, which is esteemed a great luxury in the neighborhood of Philadelphia, while in the warm and turbid tributaries of the Mississippi it is nearly worthless. A good deal of confusion and misapprehension is caused also by the same name being applied in different places to fishes of widely different quality. For example: the very ordinary fish known in some places as the Sacramento Pike, is, in many localities in California, called the White Fish, which is also the name of a most valuable fish of the great lakes, which ranks in commercial importance, hardly second to the Codfish of the Atlantic. In consequence of these two very different fish being called by the same name, there are many people in California who think that when the Commissioners introduced into the State the very valuable White Fish of the Great Lakes, they were importing the almost worthless Sacramento Pike, and formed their estimate of them accordingly.

The Commissioners, it is quite probable, have made some mistakes, as is very natural in a new work of this sort, but I think it will be found on examination that they have used their means in the wisest way possible, and have introduced into the State the fish which are at the same time the most valuable and the most generally liked.

Before closing these remarks, let me say a few words about increasing the Salmon of the Sacramento River, by artificial means.

The commercial value of the Salmon of the Sacramento is undoubtedly capable of great extension. Just beyond the minimum limit of the prices of Sacramento Salmon, lies a double trade in these fish, each branch of which, with fair opportunity, would exceed the extent of the present business of the fisheries of the river. The only reason why larger quantities of fresh Salmon are not sent East in the Winter from the Sacramento River, both in cans and in ice, is because the prices of Salmon in California are too high. If the prices were reduced a little, by increasing the abundance of the fish, both these trades would then open up in very large proportions. The case is exactly parallel with that of most exportable merchandise. The moment the cost of the goods declines beyond a certain limit, so as to make exportation profitable, a large exporting business immediately springs up. So it would be with California Salmon. They can be taken to Truckee any time in the Winter, and frozen in a few hours, and then shipped with perfect safety to Chicago and New York, and sold there at remunerative prices and in great quantities, if the original cost of the fish in California is not too great.

The same is true in regard to canned Salmon—a form of preserving Salmon which has brought enormous returns to operators on the Columbia River. Salmon cost too much at present on the Sacramento River, but if they could be increased so as to sufficiently reduce the first cost, canning Salmon could be carried on, on the Sacramento, at a profit, and with this advantage over the Columbia River, that the freight from Oregon to California would be saved—an item in the Columbia River trade which alone amounts to hundreds of thousands of dollars annually. To show what a canning business could be done on the Sacramento River, if Salmon could be obtained cheaply enough, it is only necessary to say that there were, in round numbers, twenty million pounds of canned Salmon exported from the Columbia River last year, at a cost value of two million dollars. The canning business on the Columbia employs one thousand eight hundred men. The cost of the tin alone consumed by the canners on the river, amounts to several hundred thousand dollars. It is unnecessary to speak of the advantages that such a business would bring to the State of California. I do not say that the canning of Salmon would ever be brought up to the same proportions on the Sacramento that characterizes the business on the Columbia River, but if Sacramento Salmon would be made abundant enough to be cheap, something of very considerable importance could undoubtedly be done in this direction, which, added to the shipping of frozen Salmon, would make the exporting of Sacramento Salmon a very valuable branch of industry in the State.

That the Salmon can be thus increased in the river so as to be made cheap enough to export in the Winter, seems to be a matter of very great certainty. The artificial propagation of Salmon has been carried to such a point of proficiency that with any given number of fish, ninety-five times as many young Salmon can be brought into existence as would be naturally produced by the Salmon themselves, for, in artificial propagation, ninety-five per cent of the eggs are hatched, while by the natural process not over one per cent is hatched. A moment's consideration will show that with this enormous advantage the Salmon can be increased to an almost incredible extent, if it is practicable to employ the artificial method successfully.

That it is practicable, has been already proved beyond a doubt, by the success of the United States Salmon breeding establishment on the McCloud River, in Shasta County, of this State. This station of the United States Fish Commission has now been in operation four seasons, and last year contracted to place in the tributaries of the Sacramento River one million young salmon, at a cost of one thousand dollars, or one dollar per thousand. Eight hundred and fifty thousand young Salmon under this contract have been delivered, and the remaining one hundred and fifty thousand will be placed in the river this Fall. At this rate, it will be seen at once that the Salmon of the Sacramento can be increased indefinitely, and at a very slight expense. Five million young Salmon could be placed in the Sacramento River, any year, at a cost of five thousand dollars. A comparatively small annual expenditure would keep the river constantly stocked, so that Salmon would become plentiful enough to make it profitable to can them and send them fresh to the East in the Winter. With the river well stocked, instead of the small business that is now carried on in Salmon on the Sacramento River, a large industry would spring up on the river, employing hundreds of men, and bringing in a large revenue to the State. This increase of Salmon in California could not only be effected at a very inconsiderable expense, but it would, as far as the State Treasury is concerned, be a self-supporting institution, for the augmented business of the Salmon fisheries would, by its revenue to the State, pay the appropriation required; and besides this, there would be the vast increase of fish food to the community, which would offset the appropriation many times over.

The money that is appropriated by the State for fish culture is not invested in a non paying object, like a monument or a building, but in a work that not only pays an immensely remunerative interest to the State in one way, but actually returns the money to the Treasury in another way.

I have spoken particularly thus far in regard to the improvement of the regular Salmon fisheries of the Sacramento by artificial propagation, but there are incidental results brought about by this agency which, though not of so much importance, should not be overlooked. Most sportsmen, at least of the State, have heard of the great numbers of Grilse (young Salmon) that were caught by hook and line in the Bay of San Francisco last Spring, and the fish of the same kind that were caught in Lake Merced in the same way. These afforded a great amount of sport to the anglers of the city and the neighborhood, besides yielding a very considerable amount of excellent fish-food. The abundance of Grilse in these waters was the direct effect of the labors of the Fish Commissioners. With so auspicious a beginning, who can say what cannot be accomplished in time in this direction by the Fish Commission, with reasonable encouragement. Such encouragement ought certainly to be given them. Massachusetts, New York, Connecticut, Pennsylvania, Michigan, Virginia, and many other States, have made ample provision for their Fish Commission, and have considered themselves well repaid. There seems to be no reasonable course left for the State of California but to go and do likewise.

LIVINGSTON STONE.

THE CALIFORNIA AQUARIUM CAR OF EIGHTEEN HUNDRED AND SEVENTY-FOUR.

S. R. THROCKMORTON, ESQ., *Chairman of California Fish Commission:*

SIR: I beg leave to report as follows:

On the morning of the first day of April, eighteen hundred and seventy-four, I received the following telegram:

"SAN FRANCISCO, March 31st, 1874.

"LIVINGSTON STONE: We want you to bring out another aquarium car.

"S. R. THROCKMORTON."

Acting on this intelligence I went to Boston that afternoon to begin preparations for the trip in general, but particularly to inaugurate a series of experiments in the transportation of Lobsters, it being very difficult to keep them alive, away from the ocean, long enough to make the overland trip.

I obtained twelve live Lobsters, some sponges, and a barrel of ocean water, and, having made arrangements for future supplies, as occasion might require, I returned to Charlestown, N. H. The points which were brought out by these Lobster experiments, which I continued for several weeks, are substantially as follows:

First—Lobsters can be kept alive, away from the ocean, twelve days, under the most favorable circumstances.

Second—They will not stand exposure to the dry air, at all, whether warm or cold.

Third—They will not live in still sea water, whether warm or cold.

[NOTE.—The motion of the tides is probably essential to their health in their natural state.]

Fourth—Fresh water kills them very soon.

Fifth—Artificial sea water (salt dissolved in fresh water) is not nearly as favorable to life as the genuine article from the ocean.

Sixth—The confinement of several together in one apartment is injurious, as they will bite off each other's claws.

Seventh—Rubber bands around the claws to prevent their biting each other is unfavorable to life.

Eighth—The best way yet found for keeping Lobsters alive, in confinement, is to pack them in separate compartments in sponges wet with ocean water. They should be kept as cold as possible, and the ocean water should be renewed twice a day.

A description of an experiment by Mr. F. W. Webber is appended.

"On Wednesday, the fifteenth day of April, eighteen hundred and seventy-four, thirteen live Lobsters arrived at the Cold Spring Trout Ponds, Charlestown, N. H., and were divided into four lots as follows:

"Three Lobsters were packed in a box among sponges wet with sea water, and kept in a cold temperature with ice. Four Lobsters, having rubber bands on their claws to prevent their injuring each other, were packed in a similar manner, and kept without ice at a warmer temperature. Three Lobsters without bands on their claws were packed in the same way, and kept at a similar temperature. Three Lobsters were packed among sponges wet with a little artificial brine made from coarse salt and spring water, and kept at a mild temperature. The boxes all had large cracks in them through which the water from the sponges would easily run off, and thus prevented from becoming stagnant in the bottom of the boxes.

"Results: Of the three Lobsters kept in the artificial brine one was found dead on Thursday morning, April sixteenth; one on Saturday morning, April eighteenth; and one lived till Monday morning, April twentieth.

"Of the four kept at a mild temperature with the bands on their claws, in sponges wet with sea water, one was found dead on Saturday morning, April eighteenth; one on Saturday night, April eighteenth; one on Sunday night, April nineteenth; and one on Monday morning, April twentieth.

"Of the three which were kept in the sponges wet with sea water at a moderate temperature, without bands on their claws, two were found dead on Tuesday evening, April twenty-first, and one lived till the evening of April twenty-sixth.

"Of the three kept at a cold temperature, among the sponges moistened with sea water, one died Monday morning, April twentieth; one died Wednesday morning, April twenty second; and one died Thursday morning, April twenty-third.

"In all the above experiments the water in the sponges was renewed twice a day; ocean water being used throughout in the three first experiments, and artificial brine in the last.

"It will be observed that the Lobsters treated with artificial brine began to die first.

"Of those kept cold and treated with ocean water, one lived seven days, and one eight days. Of those treated with ocean water, and kept at a moderate temperature, without ice, one lived eleven days.

"On the arrival of these Lobsters, some of the spawn was taken from one and packed away in sponges wet with sea water, which wetting was renewed every day. On Tuesday, April twenty-eighth, a few of them were examined under a microscope, and the pulsations of the blood could be distinctly seen in the region of the little filament which connects the eggs."

While these experiments were in progress, I made preparations in various directions for securing several varieties of fresh-water fish. On the twelfth of April I received a letter containing the following extract:

"Bring especially Shad, Eels, Lobsters, Black Bass, and, perhaps, Catfish. Bring Blue Fish and Striped Bass. No Perch, nor Trout.

(Signed:) "S. R. THROCKMORTON."

This was the first information I had received that salt-water fish were wanted, and I hesitated at undertaking to carry them, for, as will be easily seen, to combine salt water fish, *e. g.* Blue Fish, shell fish, *e. g.* Lobsters, fresh-water fish that required warm water, *e. g.* Shad, and those that required cold water, *e. g.* Bass, was very much complicating an enterprise which, even in its simplest form, was an exceedingly difficult and critical one. I concluded, however, to take the salt-water fish (though somewhat against my better judgment), and immediately went to New York to make arrangements for obtaining them alive. I also put myself in communication with Professor Baird on the subject, and with Captain Vinal Edwards, of Woods' Hole. I then went to Lake Champlain for the Black Bass and Glass-eyed Perch.

Meanwhile I exerted myself to the utmost to secure a suitable car for the purpose, but, to my great dismay, could not get one. I was very particular that the car should be just what was wanted. Such a car must be forty feet long—a passenger baggage car—with twelve wheels, air brakes, Miller platform, and wide tread. The difficulties that now arose, in the way of getting such a car, were legion.

I applied to the Central Vermont Railroad, the Boston and Albany, the Great Western Railroad, the New York Central, the Central Pacific, and other railroad companies, but with unfavorable results in every case. All kinds of cars were offered, from the plainest box freight car to the regular passenger car, but all presented some objections which prevented them from meeting the requirements. Some had not the air brakes, some were not long enough, some had too narrow a tread, and so on. I was about giving up in despair, and had actually telegraphed to California for parties there to get a car if they possibly could, when I received a dispatch from Mr. Sargent, Superintendent of the Michigan Central Railroad, to the effect that he would furnish a car exactly suitable for the purpose. A bargain was immediately closed with him, and on the eleventh of May, the car was at Charlestown, New Hampshire. It was a large, strong, well built, and handsome car, with wide tread, twelve wheels, Miller platform, and air brakes, and was in every way adapted for the purpose.

By this time I had collected large supplies of fresh-water fish at Charlestown, New Hampshire, and parties at work in various quarters were securing the proper sizes of other fish for the expedition. The main thing now remaining was to fit up the car for the journey. With the great variety of fish which I had now arranged to take, it was obviously impossible for any force that I could carry with me to keep the water aerated by hand; I therefore turned my attention to devising some machinery which would do the aerating automatically. Three plans presented themselves. The first was to catch the air in large funnel-mouthed pipes, placed on the top of the car, and to trust to the motion of the car to force it into the tanks. One of these was accordingly rigged on the car, and we made a trial trip to Bellows Falls. The experiment was an entire failure, for, though a large volume of air was carried through the pipe into the car, it did not come with force sufficient to displace the water when the inside end was inserted in a tank. The next plan was to force the air in, by means of fans or small windmills on the top of the car, to be kept in motion by the progress of the train. Upon further examination, however, this was given up as impracticable. The third plan, and the one finally adopted, was to attach machinery to one of the axles of the car, in such a way as to acquire sufficient power to work a pair of air pumps. This was done by passing a belt around the axle, and continuing it, through a hole in the car, to a counter-shaft inside. The counter-shaft was provided with two pulleys, around each of which a belt was passed, which connected with the crank-wheel of the air-pumps. Attached to each air-pump were two main pipes, passing through the entire length of the car, from which led, at suitable intervals, a dozen or so smaller pipes, of flexible rubber hose, and of sufficient length to reach all the tanks, and in fact every part of the car. Whenever the train was in motion the rotation of the axle revolved the counter-shaft, which in turn worked the air-pumps. These pumps, at every stroke of the piston rod, forced the air through each piece of hose with great power, so that when the end of the hose was inserted into a tank the water boiled violently. The operation of this plan of aerating the water was perfect. The belting being adjusted and the hose dropped into the tanks, as soon as the train got under headway the wheels on the counter-shaft revolved briskly, the piston rod of the air-pump worked with great rapidity, and the water in every receptacle in the car fairly boiled with the commotion caused by the fresh air forced through it. Nothing more perfect or more entirely answering its purpose could be asked or wished, and it is a convincing confirmation of the efficiency of the apparatus, though it sounds somewhat paradoxical to say it, that the Bass and many other fish were, at the end of their journey, in better condition, owing to their unusual supply of oxygen in transit, than when they started from New Hampshire. At all events, it is true that only one out of seventy-five full-grown spawning Bass was lost during their long confinement of eight days and nights, and that one was killed by the falling of a cake of ice.

The mechanical working of the machinery was perfect, and never once got out of order during the trip, or failed to do its duty. I have no doubt that all full-grown fresh-water fish requiring aerated water, such as Trout, Black Bass, Glass-eyed Perch, land-locked Salmon, Perch, and the like, could be taken to California and brought back with the help of this apparatus, with perfect security, and without any deterioration in the condition of the fish.

The belting around the axle passed up nearly perpendicularly through the bottom of the car. The counter-shaft and air pumps were placed as near the ceiling as possible, so that the whole thing took up very little room, and was very little in the way.

To resume the chronological order of my narrative: The first two plans of aerating the water having been abandoned, I proceeded at once to make arrangements for testing the third plan, just described. The pumps, shaft, belting, and pipes were procured, a hole made through the bottom of the car over one of the axles, each part of the machinery put in its place, and permission obtained from the Central Vermont authorities to run the car to North Charlestown, on a trial trip.

Everything being ready, the trip was made, several friends and persons interested in the expedition accompanying us. No sooner was the train in motion than it became obvious that the much sought for object was accomplished. The moment the hose was dropped into a tank of water it became a boiling spring. A load of anxiety was taken from my mind, and I returned to Charlestown that night for the first time confident of success.

Nothing now remained but to complete the furnishing of the car, and to concentrate the various collection of fishes. As long as it was decided to try salt-water fish, I concluded to improve the opportunity by experimenting with several kinds, the same salt-water arrangements in the car answering as well for several varieties as for one. This considerably increased the number of varieties to be gathered together. There were Black Bass, Glass-eyed Perch, and Horn-pouts, from Lake Champlain, now quartered at the Cold Spring Trout Ponds, at Charlestown, New Hampshire. There were Lobsters and Oysters, at Boston. Lobsters, Salt-water Eels, Tautog, and Striped Bass, at Woods' Hole, Massachusetts. Shad and Fresh-water Eels, at Castleton, on the Hudson River. Catfish, at the Raritan River, New Jersey. Kingfish, Weak-fish, and Striped Bass, at New York Harbor. Alewives, at the Mystic River, Massachusetts. Additional Bass, at Niles, Michigan, and Mississippi Catfish (*Grystes Salmonides*), or Mississippi Bass, at the Elkhorn River.

I dispatched Mr. M. L. Perrin to New Jersey, for the Catfish, and having stowed them safely away at the Cold Spring Trout Ponds, detailed him again, to take charge of the Woods' Hole and Boston fish, which were to be brought from Boston in a special car, with the reserves of ocean water, the night previous to the departure of the aquarium car for California. I then sent Mr. Myron Green and Mr. Waldo Hubbard for the New York fish, and Mr. E. C. Forbes was sent to Castleton, to get the Shad and Eels. Mr. Richard Hubbard I retained at Charlestown, to assist me there. I also telegraphed to Mr. George H. Jerome, of Michigan, to intercept the train at Niles, with the Michigan fish, and Mr. George Bemis, of Omaha, to do the same at the Elkhorn River, with the Nebraska fish.

In the meantime I devoted myself to completing the arrangements of the aquarium car. These, when finished, may be described as follows: At the forward end of the car, and occupying the entire width of it, was a large fresh-water tank, made of two-inch pine plank, lined inside with tin and bound firmly on the outside with iron rods. It was nine feet square and three feet high, and held upwards of sixteen hundred gallons, or about seven tons of water. The top of the tank, which was also of two-inch plank—was provided with doors which could be opened and shut, and air holes for ventilation. Just over the tanks and passing horizontally through a circular hole in the forward end of the car, was a large tin pipe, arranged on the outside to receive water from the railway tanks along the road. By this arrangement we could throw into our large tank a ton of water a minute. The tank was also provided with an outlet through the bottom of the car for draining off the waste water. The top of the tank was provided on each side with racks for holding ice.

In the center of the car and occupying about six feet of the length of it, were four berths, built up against either side, and extending out from the wall about two feet, leaving a passageway of five feet between. Beyond the berths, cupboards and shelves were constructed on one side, the other being left vacant for the boxes of Lobsters. At the rear end of the car, were two salt-water tanks, of two-inch plank, each nine feet long, four feet wide, and three feet high, holding about seven hundred and fifty gallons, or upwards of three tons of water each. These were covered at the top with two-inch plank and furnished with doors like the fresh-water tank. Just in front of the salt-water tanks were the revolving belt and counter-shaft, and about eight feet back and nearly at the roof of the car, were the two air-pumps, from which extended forward again, through the car, the system of aerating hose. All the spare space was occupied with movable tanks containing the different varieties of fish.

Besides these larger objects of the furniture of the car, there were a hundred smaller articles for the emergencies of the journey, as, for instance, thermometers, pails, nets, etc.

The fourth of June was set for the day of our departure. On that day and the day previous there were at least fifty men working at Charlestown, and at the other points of rendezvous, for the expected journey. Through the help of telegraphic communication every man was at his post at the required moment, and every man performed his part at the proper time, so that, with all the myriad separate details that had to be combined in one whole that morning, not one was overlooked nor forgotten, nor was there a delay or a drawback of any sort to prevent a perfectly successful departure.

Mr. Perrin arrived at midnight of the third of June, with his car of fish, lobsters, oysters, and ocean water. The next morning they were transferred to the aquarium car, and the Charlestown collection of fishes put aboard. The tanks were filled; two tons of ice were taken on, and at two o'clock in the afternoon of Thursday, June fourth, the second California aquarium car started westward. We were accompanied by a party of friends as far as South Vernon. All went very smoothly up to this point, but soon after the journals of the car wheels began to heat, and we were kept at work all night and until noon the next day to keep them cool enough to prevent the car being dropped. We arrived at Albany at midnight of the same day, June fourth. Mr. Green, Mr. Waldo Hubbard, and Mr. Forbes joined us here with the New York fish, and the Shad and Eels which Mr. Monroe Green had very kindly brought from Castleton himself. I must not forget to state here that this lot of Eels—amounting to two thousand—was procured by Mr. Monroe Green, and that the Shad—numbering thirty-six thousand—as well as the Shad which I took to California last year, were contributed by the State of New York, from the State hatching works, on the Hudson River, at Castleton, in charge of Mr. Seth Green, and under the immediate care of Mr. Monroe Green, from both of which gentlemen this enterprise, and the similar one of last year, received a great deal of assistance.

Mr. Willard T. Perrin, one of the aquarium car force of last year, who had accompanied the car to Albany, left us here. Our party now consisted of Myron Green, E. C. Forbes, Waldo Hubbard, Marshall L. Perrin, and myself, all of whom continued with the car to California.

Leaving Albany at half-past twelve, we arrived at Rochester an hour late, the journals heating very badly. At this point Seth Green came aboard and brought us some circular belting, for which I had telegraphed previously. We took on a ton of ice, and left Rochester twenty minutes after our arrival. Reached Suspension Bridge at two P. M. of June fifth. Here we were furnished with a new set of wheels, which delayed us till nine forty-five P. M., when we again resumed our journey, having taken on four tons of fresh water and two tons of ice. It became evident to-day that the salt-water fish would not survive the journey—in fact most of them had not reached the car alive. The carrying of them was a new thing and had not been experimented upon, and really did not form a part of the original plan of the aquarium car, so that the loss did not seem so discouraging as it might otherwise have done. The fresh-water fish continued in splendid order. We reached Niles, Michigan, the next day, at four o'clock and twenty minutes P. M., where we met the Hon. George H. Jerome, who had with him a fine lot of Black Bass, which he had very kindly collected at my request. We all felt under great obligations to Mr. Jerome for the pains he had taken to procure the fish, and also for the very kind interest and sympathy which he expressed for the success of the expedition. Mr. H. H. Sargent, the Superintendent of the Michigan Central Railroad, who provided the car, also came aboard at Niles. We owe this gentleman many thanks for the courteous and accommodating spirit which he manifested from beginning to end, in all our dealings with him.

We arrived at Chicago at eight o'clock and thirty minutes P. M., of the same day, Saturday, June sixth. Here we had to wait all night for a train direct for San Francisco. The pumps, of course, ceasing to work while the car was still, I kept two men at the cranks all night turning them by hand. At Chicago we took on five tons of water, and two tons of ice, and left there the next morning at ten o'clock and forty-five minutes A. M.; crossed the Mississippi at four o'clock and twenty-five minutes P. M., the same day, and put a few Salmon and Shad in the river as an experiment. Took on four tons of water at Cedar Rapids, and reached Omaha at ten o'clock and thirty minutes the next morning, Monday, June eighth. Up to this time the fresh-water fish had done splendidly, no loss of any kind occurring except among the small Eels. The Black Bass, Glass-eyed Perch, Catfish, Horn pouts, Penobscot Salmon, and larger Eels, were in fine condition—about half of the Lobsters had died. The Oysters for Great Salt Lake, and the Tautog for the Pacific, and the Shad, were all in good order. The other salt-water fish had given up the battle.

We came into Omaha with the journals of our forward pair of wheels very hot. An examination showed them to be so badly cut, that it was necessary to put in another new pair of wheels—the authorities of the Union Pacific Railroad very kindly consenting to hold the train till it was done, for which we felt extremely grateful, as, otherwise, there would have been another day lost. At Omaha we met Mr. George Bemis, who had very obligingly consented to have some Nebraska fish in readiness for us at the Elkhorn River, and I must not neglect this opportunity of saying that from the very beginning of my correspondence with Mr. Bemis on the subject, he manifested the most cordial disposition to assist the enterprise, and exerted himself to the utmost to do his part towards helping it along. While the new wheels were being attached to the car we took on three tons of ice, and some more circular belting kindly procured for us by Mr. Bemis, who accompanied the car as far as Fremont, Nebraska. Leaving Omaha we arrived at the Elkhorn River at two o'clock and thirty minutes P. M., exactly a year, within a half an hour, from the time when we went through the bridge into that river with the first aquarium car.

Through the courtesy of Mr. C. B. Havens, the train dispatcher of the Union Pacific Railroad Company, at Omaha, we were permitted to stop the train at the river, and to hold it there till we had taken on some Western Bass and Mississippi Catfish, procured through the agency of Mr. Bemis, and fifty gallons of water which we brought up from the river in pails. By a sort of poetic justice the very river which had swallowed up our car-load of fishes last year was made to contribute to the success of this year's expedition.

Thus far the weather had been very hot. To-night (June eighth) it was quite cool, and about midnight we encountered a terrific storm, which stopped the train awhile. The next morning dawned cool and rainy, and in the course of the forenoon there came a furious hail storm.

We now thought we had a fair prospect of getting through with all we had on board, and every thing prospered through the day, but at night a calamity happened which appalled us. It was the loss of the Shad. The circumstances were these: between the Elkhorn River, Nebraska, and the Weber River, Utah, a distance of nine hundred and fifty miles, there is no suitable water for Shad, except at the Laramie River.

When Seth Green crossed the continent in eighteen hundred and seventy-one, and when I crossed it with Shad, in eighteen hundred and seventy-three, the water in the Laramie River was good, and up to to-day, we had received no information to lead us to think anything to the contrary. We were consequently depending on keeping the Shad on Laramie River water, from Laramie to the Weber. As we approached Laramie, however, we heard various rumors to the effect that the recent rains had washed a good deal of alkali into the river. There was no alternative for us, however, and when the train stopped there, we took a supply of Laramie River water for the Shad. This was about dusk on Tuesday evening, June ninth. I stayed with them till midnight, and left them in the hands of the long watch, who were to take them through till morning. When I got up the next morning, at daybreak, every Shad was dead. They had not been neglected an hour, nor a moment, since they left the Hudson River, and the two young men who had charge of them that morning were among my most zealous and trusted assistants, so that I am confident it was not through neglect or want of faithful care that they died. Knowing no other cause for their loss, we united in attributing it to the unusual amount of alkaline matter in the water of the Laramie, caused by the recent extraordinary rains.

All that day it seemed as if there had been a funeral on board, so depressing was the influence of this calamity to all in the car. It was a terrible disappointment to me, but knowing that every one had done his duty, I endeavored to cheer up the others by turning their attention to the fishes which were still living. We took on four tons of water at the Weber River, and reached Ogden, Utah, a thousand miles from San Francisco, at six o'clock on the evening of Wednesday, June tenth. Here I left a barrel of Oysters and two spawning Lobsters, in first-rate condition, for Great Salt Lake. Our supply of Atlantic Ocean water was exhausted to-day. I had previously telegraphed to the California Fish Commissioners for a supply of Pacific Ocean water, which we heard to-day would meet us at Winnemucca. We now had on board, all in good condition, Black Bass, Horn-pouts, Glass-eyed Perch, Rock Bass, Penobscot Salmon, fresh-water Eels, Schuylkill Catfish, Mississippi Catfish, Tautog, Lobsters, and salt-water Eels, with which varieties—ten in all—we hoped to get through alive, and, as the sequel will show, did actually succeed in bringing through safely. Leaving Ogden about dark, we arrived at Carlin, Nevada, at ten o'clock and fifteen minutes A. M., June eleventh, and took on a small supply of water. At eleven o'clock and twenty-five minutes A. M. we met the Central Pacific freight train, with the supply of Pacific Ocean water, which was transferred to our car, and immediately used on the salt-water fish, which showed every sign of being greatly refreshed by the change. Took on more fresh water at Humboldt, Nevada, at six o'clock and fifteen minutes P. M., and ten tons of ice at Wadsworth, at midnight. At Truckee, California, B. B. Redding, of the California Fish Commission, came on board, and accompanied us to San Francisco. This was the last day of the trip (Thursday, June twelfth), and no one can tell the immense relief it was to our party to know it For seven days and eight nights, with only three or four hours rest out of the twenty-four, we had kept incessantly at work over those fishes. Want of sleep was beginning to break us down. We had lived in a car full of water and melting ice, which had, literally, hardly a dry spot in it. The long journey itself, with the constant jar and rattle of the train, is enough to nearly wear one out. We had taken on board and cut up into suitable pieces and packed away, fifteen tons of ice. The unusual chill and dampness that pervaded the car, together with the immense labor and loss of sleep, had made nearly all on board sick, for a greater or less time; and altogether, the trip had been one of such extreme hardship and severe labor, that we hailed this last day with a sense of the greatest relief.

As soon as we had finished our hearty breakfast, all hands went to work to transfer the fishes into the various portable tanks in which they were to be taken to their destinations. This occupied all the time till the train reached Sacramento, at one o'clock and thirty minutes P. M., June twelfth. Here we met Mr. S. R. Throckmorton, of the California Fish Commission, and others, who took charge of the large Black Bass, the Horn-pouts, the Rock Bass, Glass-eyed Perch, and Penobscot Salmon, all being in first-rate order.

Mr. Green, Mr. Perrin, and Mr. Richard Hubbard accompanied these fish to their destinations, while Mr. Forbes, Mr. Waldo Hubbard, and myself continued with the car to San Francisco.

Upon reaching the San Joaquin River, we deposited the Schuylkill and Mississippi Catfish safely in that river, in the presence of quite a large number of people, who left the train to see the deposit made. At Alameda Creek we deposited the small Black Bass; at an inlet of the Bay of San Francisco, near Oakland, we left the Tautog and salt-water Eels; and the Lobsters we deposited in the bay itself. In the meantime, the remainder of the party, who left the car at Sacramento, placed the Glass eyed Perch in the Sacramento River; the Horn-pouts and fresh-water Eels in an inlet, or slough, of the Sacramento River; the Penobscot Salmon in the same river, at Redding; and the Black Bass in the upper waters of Napa Creek. The car was left at Oakland.

So ended the expedition of the second California aquarium car, just eight days and nine hours from the time it left Charlestown, New Hampshire. In all the features of the original plan of the expedition it was a success. The eleven varieties of fish which this plan contemplated, were brought through alive, and successfully deposited The taking of the salt-water fish was an afterthought, and can only be regarded in the light of an experiment. The Shad were lost, it is true, but I had already brought the year before five thousand Shad to Great Salt Lake, and thirty-five thousand to the Sacramento River. The fish which did survive, except the Lobsters, arrived in splendid order, it being a fact (as before mentioned) that the Black Bass, and others, seemed in better condition than when they left New Hampshire. The Lobsters were in a feeble condition, but had a vast quantity of impregnated spawn with them in good order. The result of the expedition was to introduce into the public waters of California eleven varieties of fish not native to the State. The attempt to carry salt-water fish across the continent need not necessarily be abandoned as impracticable because it was not a success on this particular occasion. The circumstance that the salt-water fish did not live, finds a very simple explanation in the fact that nothing was known about transporting them, and no time was afforded this season for finding out by experiments. This difficulty can, of course, be avoided on a subsequent expedition, by taking ample time beforehand to discover how the sea fish of the Atlantic can be kept alive sufficiently long to survive the overland journey, and by giving them the treatment which it has been found they require; then the enterprise can be made successful.

Respectfully, LIVINGSTON STONE.

LIST OF PLACES WHERE ICE WAS TAKEN ON BOARD.

		Tons.
1874.		
June 4th....	Charlestown, New Hampshire..........	2
June 4th....	Albany, New York..........	1
June 4th....	Rochester, New York..........	1
June 5th....	Clifton, Canada..........	2
June 7th....	Chicago, Illinois..........	2
June 8th....	Omaha, Nebraska..........	3
June 11th...	Wadsworth, Nevada..........	2
	Total..........	13

LIST OF PLACES WHERE WATER WAS TAKEN IN.

		Ocean water—tons.	Fresh water—tons.
1874.			
June 4th..........	Charlestown, New Hampshire..........	5	7
June 5th..........	Clifton, Canada..........	....	4
June 7th, (A. M.)..	Chicago, Illinois.	....	5
June 7th, (P. M.)..	Cedar Rapids, Iowa..........	....	3
June 8th..........	Elkhorn River, Nebraska...	....	¼
June 9th..........	Laramie, Wyoming Territory..........	....	2
June 10th..........	Ogden, Utah..........	....	4
June 11th, (A. M.)	Carlin, Nevada..........	....	1
June 11th, (P. M.)	Winnemucca, Nevada..........	1	....
June 11th, (P. M.)	Humboldt, Nevada..........	....	2
		6	28¼

AQUARIUM CAR, 1874.

List of fishes which arrived alive at their destinations, and the waters into which they were introduced.

Number started with.		Where procured.	Number deposited.	Place of deposit.
	Fresh-water fish.			
75	Full-grown Black Bass	Lake Champlain, Vermont	73	Napa Creek.
24	Small Black Bass (*Grystes fasciatus*)	St. Joseph's River, Michigan	12	Alameda Creek.
18	Full-grown Glass-eyed Perch (*Lucio perca*)	Missisquoi River, Vermont	16	Sacramento River.
76	Large Schuylkill Catfish	Raritan River, New Jersey	74	San Joaquin River.
	Mississippi Catfish	Elkhorn River, Nebraska		San Joaquin River.
71	Horn-pouts (*Pimelodus*)	Lake Champlain, Vermont	70	Ponds and sloughs near Sac'to.
4 (cans).	Small Silver Eels (*Anguilla*)	Hudson River, New York	1 (can).	Sacramento River.
450	Small Penobscot River Salmon (*Salmo salar*)	Penobscot River, Maine	305	Redding, Sacramento River.
6	Full grown Rock Bass	Missisquoi River, Vermont	4	Napa Creek.
	Salt-water fish.			
24	Small Tautogs (*Tautoga Americana*)	Woods' Hole, Massachusetts	23	San Francisco Bay.
2 (cans).	Small Salt-water Eels (*Anguilla*)	New York Harbor	1 (can).	Lakes at Sutterville.
150	Full grown spawning Lobsters	Massachusetts Bay	2	Great Salt Lake, Utah.
			4	San Francisco Bay.
1 (barrel).	Oysters	Massachusetts Bay	1 (barrel).	Great Salt Lake, Utah.

The following is an account of the receipts and expenditures since the last report:

1874.	By cash on hand—last report		$17 22	
March 5...	By freight returned from Railroad Companies on account of loss of aquarium car		1,250 00	
July 11....	By appropriation for fiscal year		2,500 00	
July 20....	By error on purchase of ice		12 50	
1875.				
July 9......	By appropriation for fiscal year		2,500 00	
				$6,279 72
1874.				
May 27....	To cash paid—Stone's draft (aquarium car)	$539 69		
June 5......	To four barrels for salt water	7 50		
June 8......	To cash paid—Stone's draft aquarium car and telegraphing, etc	1,122 75		
June 13....	To cash paid Stone on occount of aquarium car, telegraphing etc	300 80		
June 19....	To cash paid U. P. Railroad Co., fare of Stone and assistants, accrued in 1873	270 75		
June 22....	To cash paid Fenton for transporting Trout to American River	15 50		
June 22....	To cash paid Graham—cleaning cans and cartage of same	7 00		
July 3......	To cash paid Stone on account of aquarium car	200 00		
Sept. 30....	To drayage of cans	3 46		
Nov. 8.....	To telegram	25		
Nov. 8.....	To cash paid Stone's order on account of aquarium car	200 00		
1875.				
March 1...	To postage stamps	1 00		
March 5...	To cash paid H H. Haight, attorney's fees	100 00		
March 5...	To cash paid for ice used in transporting fish to American River and Prosser Creek	4 40		
March 11..	To lumber for hatching house at Berkeley	97 55		
March 11..	To gas pipe and labor on hatching house at Berkeley	67 45		
March 11..	To J. G. Woodbury's wages on same, and hatching Whitefish and Trout	307 80		
March 15..	To cash paid S. R. Throckmorton on account of expenditures	119 00		
March 30..	To expenses of putting Whitefish in Tulare Lake	5 00		
March 30..	To J. G. Woodbury's salary and expenses in March	158 40		
April 28...	To printing circular	6 00		
May 28.....	To cash paid on account of purchase of Trout eggs	200 00		
June 14....	To cash paid on account of hatching one million Salmon	500 00		
July 6......	To cash paid on account of hatching one million Salmon	400 00		
August 4..	To cash paid on account of hatching one million Salmon	350 00		
	Cash to balance	1,295 42		
				$6,279 72

This balance of $\$1,295\frac{42}{100}$ will be consumed by debts owing and expenses necessary to be incurred prior to the meeting of the present Legislature.

All of which is respectfully submitted.

B. B. REDDING,
S. R. THROCKMORTON,
J. D. FARWELL,
Commissioners.

COMMISSIONERS OF FISHERIES.

UNITED STATES.

Professor Spencer F. Baird	Washington, D. C.

MAINE.

E. W. Stillwell	Bangor.
H. O. Stanley	Dixfield.

NEW HAMPSHIRE.

Oliver N. Noyes	Henniker.
John S. Wadleigh	Laconia.
A. C. Fifield	Enfield.

VERMONT.

M. C. Edmonds	Weston.
M. Goldsmith	Rutland.

MASSACHUSETTS.

Theodore Lyman	Brookline.
E. A. Brackett	Winchester.
Asa French	South Braintree.

CONNECTICUT.

William M. Hudson	Hartford.
Robert G. Pike	Middletown.
James A. Bill	Lyme.

RHODE ISLAND.

Newton Dexter	Providence.
Alfred A. Reed, Jr	Providence.
John H. Barden	Rockland.

NEW YORK.

Horatio Seymour	Utica.
Robert B. Roosevelt	New York City.
Edward M. Smith	Rochester.

MICHIGAN.

J. J. Bagley	Detroit.
George H. Jerome	Niles.
George Clark	Ecorse.

NEW JERSEY.

J. R. Shotwell	Rahway.
G. A. Anderson	Trenton.

VIRGINIA.

William B. Ball	Mid Lothian.
Asa Wall	Winchester.

ALABAMA.

Charles S. D. Doster	Montgomery.
Robert Tyler	Montgomery.
D. R. Huntley	Courtland.

CALIFORNIA.

S. R. Throckmorton	San Francisco.
B. B. Redding	San Francisco.
J. D. Farwell	San Francisco.

PENNSYLVANIA.

H. J. Reeder	Easton.
B. L. Hewitt	Holidaysburg.
J. Duffey	Marietta.

OHIO.

John Hussy	Lockland.
J. H. Klippart	Columbus.
E. T. Sterling	Cleveland.

IOWA.

S. B. Evans	Ottumwa.
B. F. Shaw	Anamosa.
C. A. Haynes	Waterloo.

MINNESOTA.

A. W. Latham	Excelsior.

DOMINION OF CANADA.

W. T. Whitcher	Ottawa.
W. H. Fenning	St. John.

REPORT

OF THE

COMMISSIONERS OF FISHERIES

OF THE

STATE OF CALIFORNIA

FOR

THE YEARS 1876 AND 1877.

hns 2947

To His Excellency,
William Irwin,
Governor of California:

The Commissioners of Fisheries for the State of California, appointed under an Act of the Legislature, entitled "An Act to provide for the restoration and preservation of fish in the waters of this State," approved April second, eighteen hundred and seventy, respectfully submit their Fourth Biennial Report.

REPORT.

SALMON (SALMO QUINNAT).

Before the discovery of the gold mines in California, nearly all of the tributaries of the Sacramento and San Joaquin Rivers were the spawning beds of the salmon. Soon after mining commenced the sediment deposited by gold washing covered the gravel bottoms of the streams, The fish found no proper place on which to deposit its eggs, and after three or four years became extinct in those tributaries. The instinct of the fish leads it to return from the ocean to the stream in which it was born for purposes of reproduction. If this place, for any reason, is rendered unfit, it will not seek a new and appropriate place. In eighteen hundred and fifty the salmon resorted in vast numbers to the Feather, Yuba, American, Mokolumne, and Tuolumne Rivers for purposes of spawning, and many places, such as Salmon Falls, on the American, were named from the abundance of these fish. On the Yuba River, as late as eighteen hundred and fifty-three, the miners obtained a large supply of food from this source. At the present time no salmon enter these streams. It would be safe to estimate that one-half the streams in this State to which salmon formerly resorted for spawning, have, for this purpose, been destroyed by mining. As mining is the more important industry, of course, for this evil there is no remedy, other than by artificial means to increase the supply in those tributaries that are still the resort of these fish. The principal spawning grounds remaining, are the McCloud, Klamath, Little Sacramento, and Pit Rivers in the northern part of the State, and the San Joaquin and Merced in the southern. The short streams entering into the ocean from the Coast Range of mountains from Point Conception, in latitude 34° 20′ north to the boundary of Oregon, are also spawning grounds for salmon. The fish of the coast streams deposit their eggs in January and February, during the winter rains, when the streams are full, while the salmon of the tributaries of the Sacramento and San Joaquin spawn in August and September, when the water is at its lowest stage. The salmon of the short coast rivers do not average as large as the Sacramento salmon, but they are probably the same fish with habits modified to suit the streams to which they resort.

The *salmo quinnat* readily adapts itself to a life in fresh water, and reproduces its kind where it has no opportunity to go to the ocean. When the dams were constructed on the small streams that go to make the reservoirs of San Andreas and Pillarcitos—which supply the City of San Francisco with water—as also when the dam was constructed on the San Leandro, to supply the City of Oakland, the young of the salmon that had spawned the year previous to the erection of these dams, remained in the reservoirs and grew to weigh, frequently, as much as ten pounds; these reproduced until the reservoirs have been stocked. As the supply of fish increased the quantities of food lessened, so that the salmon have gradually decreased in weight until now, after nine years, they do not average more than two pounds. From the fact that, when food was in abundance, they grew to weigh from eight to twelve pounds, and that, as they increased in numbers, they averaged less in size, but still continued to spawn and produce young fish, it would seem that the Sacramento salmon may be successfully introduced into large lakes in the interior of the continent, where, in consequence of dams or other obstructions, they would be prevented from reaching the ocean. The history of this fish in these small reservoirs shows, that all that is requisite for their successful increase is the abundant supply of food, to be found in larger bodies of fresh water. Salmon, fully mature, weighing two pounds, and filled with ripe eggs, were taken, in September, eighteen hundred and seventy-seven, in the waters of San Leandro Reservoir. These fish were hatched in the stream which supplies the reservoir, and by no possibility had ever been to the ocean. The San Leandro is a coast stream, not exceeding fifteen miles in length, and empties into the Bay of San Francisco. It contains water in the winter and spring, at which time, before the reservoir was constructed, the salmon sought its sources for the purpose of spawning. There was never sufficient water in the months of August or September to permit the fish to reach their spawning grounds. After the construction of the reservoir, large numbers of salmon that came in from the ocean in January and February were caught at the foot of the dam and transported alive and placed in the reservoir above. The descendants of these fish thus detained in fresh water and not permitted to go to the ocean, have so far modified the habits of their ancestors that they now spawn in September, instead of in January and February. Inasmuch as these fish spawn in the McCloud, in the headwaters of the Sacramento, and at the sources of the San Joaquin, in the Sierra Nevada, in September, and in the short coast range rivers, in January and February, and as, when changed to other waters, their eggs ripen at a time when the conditions of their new homes are most favorable for reproduction, they show a plastic adaptability, looking to their future distribution, of much practical, as well as scientific, importance.

The statistics hereafter given of the temperature of the water through which the Sacramento and San Joaquin salmon pass to reach their spawning grounds, show that they swim for hundreds of miles through the second hottest valley in the United States, during the hottest portion of the year, where the mean temperature of the air is 92° Fahrenheit, and of the water, 75°. These statistics have been obtained from the record kept by the Central Pacific Railroad Company, and are for the months of August and September of the years eighteen hundred and seventy-five, eighteen hundred and seventy-six, and eighteen hundred and seventy-seven. They are of importance as showing that the Sacramento salmon will enter rivers for spawning purposes, where the water is so warm that the eastern salmon (*salmo salar*), if it were to meet it, would turn back to the ocean. They are also of importance as illustrating the probability that there are many streams on the Atlantic Coast, from the Potomac to the Rio Grande, into which this fish could be successfully introduced.

Mr. Livingston Stone, Deputy United States Fish Commissioner, in charge of the government hatching establishment on the McCloud River, reports officially that, in his opinion, all of the salmon of that river die after depositing their spawn. This is possibly true, but it does not account for the fact, that in the spawning season the McCloud contains grilse and fish evidently of three, four, and five years old, unless we are to imagine that some salmon, after being hatched and going to the ocean, remain there two, three, or more years without returning to the parent stream for purposes of spawning. Beyond doubt the salmon that spawn in the coast streams go back to the ocean, as they are frequently taken in the lagoons at the mouths of these rivers on their return. Somewhere on the tributaries of the Sacramento or San Joaquin, there are salmon that do not die after the act of spawning, for they are frequently taken in the nets of the fishermen in the brackish waters at Collinsville and Rio Vista, on their return from their spawning grounds. If it were the fact that the Sacramento salmon so widely differed from other fish that it spawned but once and then died, it would detract from its value. This subject is one of importance, but at present the facts are so obscure that we have made considerable effort to obtain the opinions and the result of the observations of the men who are practically engaged in the taking of salmon in the Sacramento River.

The following, from the letter of a fisherman who has pursued the business of taking salmon for the San Francisco market during more than fifteen years, gives some facts and his theory, based on his observations. In reply to an inquiry on the subject, he says: "As to the return of the seed salmon to the sea after depositing the spawn, I am inclined to the opinion of Mr. Stone, so far as the greater part of the female fish is concerned. I think very few of these, but many, though not all, of the males return. I should judge that five per cent. of females and twenty per cent. of males might be an approximation. I express this opinion diffidently. It is based on the style of fish caught in the lower part of the river (from Sacramento to Collinsville). After about the twentieth of September, of the fish then dropping down the nets catch but few, for the reason that the net is drifting with the current, and the fish are doing the same thing, and in consequence, as a rule, the two do not come together, and the greater part of the return fish escape. When the run is upward, the net drifts with the current, and the fish swim against it, and the rule is reversed. The percentage named above is not that of return fish caught, but of fish that I estimate may have returned, judging by the very few return fish that are caught. It is a very cloudy subject to all fishermen. I have heard perhaps a thousand discussions on the river, at all times of day and night, at the head of the 'drift,' among men of the largest experience—men right in the teeth of the business—men born to a boat and net, and grown gray and grizzled in their use—upon the point you raise, and the average conclusion always was that nobody quite knew how it was. Of one thing I am convinced, to wit, that return fish need no protection from the drifting gill net. Not one fish in ten could be caught in that way. No such thing as a run of salmon down the river ever occurs. The normal position of salmon is head to the current. Though drifting with the current, his head is toward it. In the light (or darkness) of these facts, you see how difficult it is to say, positively, what proportion of these fish that have delivered seed, return to the ocean. No man can say positively that the mass do not return. That some return is beyond doubt of a reasonable nature. If they all perish, it is certain that many survive long enough to reach the fishing grounds lying in the bays nearest the ocean. But I fail to see why the value of the California salmon is affected by the fact (if it is a fact), that the fish never spawn but once. I have a theory of the salmon of this river. It may not be scientific, but it is mine, and I can give reasons for it. It is this: the female salmon seldom or never spawns but once. The exceptions to the rule, if any, are few, and the second product of these exceptions is found in a salmon differing slightly from the mass of fish found in the river. A goodly, though not the larger part of the male salmon that have assisted in reproduction, return to the ocean and 'live long and grow broad,' and return to the river many times. On their return these fish constitute that class far above the average size. They reach thirty, forty, fifty, and even a greater number of pounds in weight, while the average weight for which our meshes are sized is from sixteen to twenty pounds. The female spawn is not ripe for delivery, nor the male fish sufficiently mature for milting, until they have made repeated trips between the ocean and the river. The yearly broods return periodically and in regular cycles; the youngest fishes arrive earliest in the season, which begins about the first of November, and do not penetrate far the first time. In the order of their birth, the other broods arrive and return to the sea, until in August and September, the great seed run, consisting of mature fish, always on time, always urgent in their movements and purposes, passes up to the headwaters. Salmon of different ages are always coming in and going out to the sea. The older the fish the longer his stay in fresh water. The younger the fish (after he once leaves for the ocean), the more of flirting about the bays and brackish water near the mouths of the river, with short excursions up the river. The foregoing is the outline of a theory, though it is derived from, and apparently justified by, known truths in the history of the Sacramento salmon during the last twenty years. I believe it to be correct; that is to say, that in any year representations of the brood of any other year not yet extinct, enter the river, and that not one-fifth of the fish that enter the river in any given year go to the headwaters that year, but that more than four-fifths return to the ocean, and, consequently, that of all the fish that come in to the river each year, but about one-fifth go to the headwaters for purposes of reproduction."

The habits of the Sacramento salmon, while on their spawning grounds in the McCloud River, have been closely observed by Deputy United States Fish Commissioner Livingston Stone, and the result of his investigations has been published by Congress in the Report of the United States Fish Commissioner Spencer F. Baird. But little is known of their habits while in the ocean. They probably feed on shoals not many miles from the shore. They are occasionally taken in the nets of fishermen in the ocean not far from the Golden Gate. Many grilse, and a few mature fish, make their appearance in the bay of San Francisco in December and remain several weeks feeding upon smelts and other small fish. During this period thousands are taken with hook and bait on lines from the Oakland pier and other wharves. Many more are also taken in the nets of fishermen. After leaving the salt water of the bay they go to the brackish waters where the currents of the Sacramento and San Joaquin meet the tide from the ocean. After entering the fresh water of the river they cease to feed. No food has ever been found in all the tens of thousands caught in the Sacramento. As it is of importance to obtain a knowledge of the habits of the salmon while it remains at the mouths of the rivers, playing back and forth between brackish and fresh water, before it makes its long and perilous journey to the head of the stream, we select from our correspondence extracts from a letter from Mr. Samuel N. Norton, of Rio Vista. Mr. Norton is a practical fisherman of many years experience, and the record of his close observation is of much value. He says: "I will give you a synopsis of one year's trip with the salmon, showing the general habits of the fish in all years while remaining in or passing through that part of the Sacramento River lying between its mouths and the point where the Feather River empties into it. For this purpose the Georgiana Slough, the Three-mile Slough around the head of Sherman Island, the San Joaquin River between these sloughs and the bay, and the Montezuma Slough leading into the northern arm of Suisun Bay from the Sacramento River, are considered as mouths of the river with like functions and processes as the main trunk of the river. Indeed, some of the best fishing ground, at certain seasons, is found in the Montezuma, Three-Mile and San Joaquin. To commence with an anachronism, the spring run begins in the fall! In November and December a very few small (as fishermen use the word—say twelve or fourteen pounds each) bright salmon appear in the river, and if no rains occur, or only slight rains, an increase in their numbers is noticed, yet they are always very scarce in those months. There are never enough to half supply the local demand of the San Francisco and other home markets. At first, in November, we pick up occasionally on their return, the last dregs of the old seed run which occurred during August and September. These are usually male fish, very dark, ill-conditioned, lank-jawed, disconsolate looking fellows, who through misfortune, incompetency or other cause,—to me not more than presumable,—seemed to have failed in their mission up the river, or to have fallen into disgrace. The last of these soon disappear. The bright ones are the *avant couriers* of the great spring run, which thus, as I said, begins in the fall. With the first heavy rains the fish that have penetrated the river recede, or as we say, back down before the thick muddy stream, retreat to tide-water in the bays and remain there reconnoitering and waiting a steady river current. Now is the time for good fishing in the bay and just in the mouths of the river. The fish are not very plentiful, but none being caught within the river proper, there is a great demand and great price against a small area of fishing ground, where all that had before penetrated the river are now concentrated. When the river becomes steady, that is, neither rising nor falling, the fish start up again, no matter how high the water may be, and by the varying moods of the river in sudden rise or fall, is the spring run mainly governed. Sudden rise or fall alike will check them. Thus it often happens that for many weeks the fish will be taken in numbers at Benicia and Collinsville, in smaller numbers at Rio Vista, and none at all farther up. Again, there have been seasons when a steady run commenced in the early part of January, and by an almost uniform rate of increase reached its culmination in May. But this is exceptional. The spring run may be stated as commencing in November and ending in July, and having its greatest strength in May. Under the most favorable conditions the months of November and December might be classed 'very scarce;' January and February, 'scarce;' March, 'not scarce;' April, 'plenty;' May, 'very plenty;' June, 'not scarce;' July, 'scarce.' Under unfavorable conditions, November, December, January, and February would have almost none at all; March, 'scarce;' April, 'not scarce;' May, 'plenty;' June, 'scarce;' July, 'almost none at all.' In defining the terms here adopted, let them be applied to the product of the labor of two men with their boat and net per day: 'Almost none at all' would mean two fish per week; 'very scarce,' two fish per day; 'scarce,' six fish per day; 'not scarce,' eighteen per day; 'plenty,' thirty-six per day; 'very plenty,' seventy-two per day. There are times in the hight of the run, when a greater number than is here named might be caught with ease, but these are exceptional. In the great run three years ago, three hundred salmon per day might be caught with ease; but in no other year, since the Anglo-American occupation, has there been such a run. It must not be understood that salmon can be caught at all times by fishing for them, even in the most limited numbers above stated. There are times when one could not be caught in a month, if life were at stake upon it. I only intend to give a fair idea of the average business. You will readily deduce from it that there are not more than two months, during the spring run, when fish can be caught in excess of the demand for home consumption. After the subsidence of the spring run in July they are often found in great numbers near the confluence of the Feather River with the Sacramento. They have a taste for variety, it would seem, and the marked difference between the cool, muddy water of the former and the warmer, limpid and clear stream of the latter, affords them great satisfaction. During the first half of August the mature seed fish start for the spawning grounds. All along the line, from the ocean to the most advanced posts along the river, the word (if fishes have words—if not, then wag) is onward and upward. They are on business, and on time; they do not shy much, nor stop for trifles; they rush at a drifting gill net determined to do or die, and of course generally die, if the net is sound. The run of August and September I have before described. As for the few belated fellows that are about in October, they might as well be caught as not—and so, my year is out."

At the time our last report was made, Mr. Charles Crocker had requested us to cause to be hatched, at his expense, and placed in streams that do not reach the ocean, a half million of Sacramento salmon. One half of these we determined to put in Kern River, which empties into Buena Vista and Tulare Lakes, and the other half in the Truckee River, which empties into Pyramid Lake, in the State of Nevada. The quarter of a million of eggs sent to Kern River, where their hatching was to be completed, unfortunately were lost. At the point on the river selected for hatching, the water contains too much alkali, it is supposed, and all the eggs died within twenty-four hours from the time they were placed in the hatching troughs. The other quarter of a million sent to the Truckee, were successfully hatched out and turned into that stream. They will go to Pyramid Lake the present season. They should return during the summer of 1878, and we are confident they will be taken in the Truckee weighing five or six pounds. Pyramid Lake is a body of water forty miles long and averaging ten miles in width, and has no outlet. It contains an abundance of food. This experiment will demonstrate how large the Sacramento salmon will grow, with plenty of food, when confined entirely to fresh water.

Since the organization of the Commission, we have caused to be hatched and placed in the streams of this State eight million three hundred and fifty thousand young salmon. These include one million paid for in eighteen hundred and seventy-five, and presented by ex-Governor Leland Stanford. As the salmon is our most important food fish, we deemed it of the greatest importance to keep up the supply. The numbers of fishermen are yearly increasing, as are also the numbers of persons who are consuming the fish. As railroad facilities are increased, and reach new points, the market becomes extended. The sea lions and seals at the outlet of the bay, being preserved and protected by law, are also increasing. They now number thousands, and as each requires from ten to thirty pounds of fish daily, it was a serious question whether we could keep up the supply by the addition of two and a half million artificially hatched each year. Since our last report, a salmon "cannery" has been established on the Sacramento, at Collinsville, and another opposite the City of Sacramento. This Collinsville canning establishment reports as having canned this year eight thousand five hundred and forty-two cases, of four dozen cans in a case, equivalent to thirty-four thousand one hundred and sixty-eight fish, weighing five hundred and forty-six thousand six hundred and eighty-eight pounds.

Under the enlightened superintendence of Professor Spencer F. Baird, United States Fish Commissioner, the Sacramento salmon is being widely distributed to streams throughout the United States. The government establishment on the McCloud River annually hatches from six to ten million eggs. These are distributed to all States having appropriate waters, whose Legislatures have appointed Fish Commissioners. From this source the State of California has received, as a donation, a half million fish each year since eighteen hundred and seventy-four. In addition, we have expended a large part of our appropriation annually, in payment for the hatching of one or two million young fish, which, through the kindness of Professor Baird, have been furnished at the actual cost of hatching. The introduction of more than eight million young salmon into the headwaters of the Sacramento, since the organization of the Commission, in addition to the natural increase, has had the effect to keep up the supply, and reduce the local market price of these fish. It is reported that the "cannery" at Collinsville has purchased all the salmon it could consume during the past season at from twenty-five to forty cents each.

Over-fishing, the absence of any close season, and no effort at artificial increase, has at last had an effect on the salmon of the Columbia River, in Oregon, and complaint is made that this river, once thought inexhaustible, has begun to fail in its accustomed supply. This decrease has been so marked during the season that the "canners" have been compelled to pay from thirty to fifty cents each for salmon. In the absence of legislation, the canning companies on this river have subscribed twenty thousand dollars, which have been placed under the control of Mr. Livingston Stone, Deputy United States Fish Commissioner, to be expended in artificial hatching, and restocking that stream. Fortunately, intelligent legislation in California made provision for continuing the supply of fish in the Sacramento before there was any marked decrease by over-fishing. It is not disputed that the salmon were more numerous in the Sacramento before their spawning grounds on the American, Yuba, Feather, and other rivers had been destroyed by mining. After the fish were destroyed in these tributaries, the supply of the State had to come from the other tributaries of the Sacramento and San Joaquin, on which there was no mining, and these latter streams furnished the normal supply. Before these became exhausted, the natural increase was supplemented by artificial hatching.

In this connection a fact, of much practical as well as scientific importance, may be stated as showing the advantages in numbers to be obtained by artificial hatching in comparison with the increase by natural methods. In eighteen hundred and seventy-six, Mr. Myron Green, foreman for Mr. Livingston Stone, United States Deputy Fish Commissioner, at the McCloud River, having observed in the river a favorite gravel bed where many salmon were depositing their eggs, carefully dug up the gravel and several thousand eggs. He separated the eggs from the gravel and placed the former, after counting them, in the hatching boxes. After twenty-four hours he found large numbers of these eggs turning white, showing that the milt had failed to come in contact with the eggs. After throwing out all the eggs found not to be fecund, there were left eight per cent. of the whole number gathered, which were found to be fertile. When the eggs and milt are artificially brought in contact out of the water, it would be carelessness or inexperience that would prevent ninety-five per cent. of the eggs from being fertilized.

The following tables will show the numbers and weight of salmon transported on the railroads and steamboats from the Sacramento and San Joaquin Rivers to the Cities of San Francisco and Stockton, from points on the river below the Cities of Sacramento and Stockton, from November first, eighteen hundred and seventy-five, to August first, eighteen hundred and seventy-six, and from November first, eighteen hundred and seventy-six, to August first, eighteen hundred and seventy-seven. They do not include the catch of the fisheries at Tehama or near the mouth of the Feather River, nor do they include the fish taken on the upper waters of the Sacramento and San Joaquin, nor the salmon brought to market by fishermen in their own boats; therefore, to the totals should be added at least twenty-five per cent. to show an approximation of the actual catch :

STATEMENT

Of salmon transported from the following stations on the Sacramento and San Joaquin Rivers to San Francisco and Sacramento, from November 1st, 1875, to August 1st, 1876.

FROM THE FOLLOWING STATIONS TO SAN FRANCISCO:

Collinsville, New York of Pacific, Rio Vista, Emmaton, Jersey Landing, Antioch, Benicia, Clarksburgh, Courtland, Martinez, Kentucky, Bradford, Sacramento, Vallejo, and Webbs.

127,843 loose salmon, weighing	3,196,075 lbs.
2,433 boxes of salmon, weighing	486,030 lbs.
3,118 sacks and baskets of salmon, weighing	311,800 lbs.
158 barrels of cured salmon, weighing	31,600 lbs.
512 barrels and boxes of smoked and dried salmon, weighing	102,644 lbs.
Total	4,128,149 lbs.

FROM THE FOLLOWING STATIONS TO SACRAMENTO:

Courtland, Benicia, Rio Vista, Collinsville, Emmaton, and Clarksburgh.

1,116 loose salmon, weighing	29,150 lbs.
106 baskets and sacks of salmon, weighing	10,600 lbs.
53 barrels of salmon, weighing	12,850 lbs.
414 boxes of salmon, weighing	57,440 lbs.

FROM ANTIOCH TO STOCKTON.

70 loose salmon, weighing	1,750 lbs.
46 boxes of salmon, weighing	9,200 lbs.
Total weight of salmon	4,249,139 lbs.

NUMBER OF STURGEON.

5,466 loose sturgeon	274,375 lbs.

STATEMENT

Of salmon transported from the following stations on the Sacramento and San Joaquin Rivers to San Francisco and Sacramento, from November 1st. 1876, to August 1st, 1877.

FROM THE FOLLOWING STATIONS TO SAN FRANCISCO:

Collinsville, New York of Pacific, Rio Vista, Emmaton, Jersey Landing, Antioch, Benicia, Clarksburgh, Courtland, Martinez, Kentucky, Bradford, Sacramento, Vallejo, and Webbs.

143,998 loose salmon, weighing	3,599,950 lbs.
1,903 boxes of salmon, weighing	384,300 lbs.
3,454 sacks and baskets of salmon, weighing	345,400 lbs.
128 barrels of cured salmon, weighing	25,600 lbs.
653 barrels and boxes of smoked and dried salmon, weighing	132,788 lbs.
8,542 boxes canned salmon, weighing	546,688 lbs.
Total	5,034,726 lbs.

FROM THE FOLLOWING STATIONS TO SACRAMENTO:

Courtland, Benicia, Rio Vista, Collinsville, Emmaton, and Clarksburgh.

1,511 loose salmon, weighing	37,775 lbs.
208 baskets of salmon, weighing	20,800 lbs.
414 boxes of salmon, weighing	74,350 lbs.
47 barrels of salmon, weighing	11,950 lbs.

FROM ANTIOCH TO STOCKTON.

106 loose salmon, weighing	2,650 lbs.
63 boxes of salmon, weighing	12,600 lbs.
Total weight of salmon	5,194,851 lbs.

NUMBER OF STURGEON.

5,913 loose sturgeon, weighing	295,650 lbs.

In our last report, after adding twenty-five per cent. to the statements of the catch which we obtained, we showed the total weight as transported from the same places, from November first, eighteen hundred and seventy-four, to August, first, eighteen hundred and seventy-five, to be five million ninety-eight thousand seven hundred and eighty-one pounds. Adding the same percentage to the totals in the above tables, and they show the catch from November first, eighteen hundred and seventy-five to August first, eighteen hundred and seventy-six, to be five million three hundred and eleven thousand four hundred and twenty-three pounds, and from November first, eighteen hundred and seventy-six, to August first, eighteen hundred and seventy-seven, six million four hundred and ninety-three thousand five hundred and sixty-three pounds.

This shows a gain of more than a million of pounds in the legal catch over any year since the organization of the Commission, and may be ascribed to the fact that our waters are now beginning to feel the beneficial effects of the millions of salmon hatched artificially and turned into the headwaters. We have no means of ascertaining the weight of fish taken out of season, but estimate that between August first and November first of this year, not less than two million pounds were taken in defiance of law.

CLOSE SEASON FOR SALMON.

We are informed that a determined effort will be made to induce the Legislature to alter the time of the close season, so that fishing for salmon may be permitted in August and September, and that the close season may be changed from these months to July. With this object in view, it is reported that the proprietors of the present "canneries" and capitalists, who have in contemplation the construction of other "canneries," have been obtaining the evidence of fishermen, to present to the Legislature, to show that July is the proper month when fishing should not be permitted.

As we have shown, in July the spring run of fish has about ceased and the fall run but commencing. It is one of the months when fish are most scarce. To permit unlimited fishing during all the months in the year except July would have the effect of exhausting our rivers of salmon within ten years. It is a simple proposition that if some of the ripe fish are not permitted to reach their spawning grounds, they cannot reproduce naturally, neither can the United States nor the State obtain eggs from which to restock the river by artificial hatching. One of the fishermen who was approached with the object of obtaining his testimony in favor of a change to July, wrote to the Commissioners September thirtieth, as follows: "The close season should never, on any possible pretense or persuasion, be pressed outside the months of August and September to give opportunity for fishing in those months. Right there is the life of the matter. The regularity, the multitudes and urgency of the seed run, the consequent ease and certainty of the catch, the fine weather for work, all present a weighty temptation to both catcher and canner." The object of a close season is, that some of the fish may be permitted to reach the headwaters to spawn. If they are not allowed to do so the race will soon be extinct. Cupidity and desire for immediate profit should not be permitted to influence legislation with the ultimate result of the extinction of the last fish. The interest of the public is that the fish be continued in the river. A change in the law that will omit August and September from the close season cannot but result in material and permanent injury.

TEMPERATURE OF AIR AND WATER.

The following statistics will be found of much importance. They exhibit the temperature of the water and air at two stations, each on the Sacramento and San Joaquin Rivers, taken for three years during the months the great army of salmon are passing up to their spawning grounds. They will show conclusively that the Sacramento salmon lives for weeks, if not months, in water much warmer than any other fish of the same family. They also show the strong probability that these fish may be successfully introduced into rivers in still lower latitudes than those of which they are native—without doubt into the waters that flow into the Gulf of Mexico, and with many prospects of success into the rivers of Europe emptying into the Mediterranean:

TEMPERATURE—(FAHRENHEIT).

Railroad Crossing at Sacramento, Sacramento River, latitude 38° 35′ *N., longitude* 121° 30′ *W.*

	AUGUST.									SEPTEMBER.								
	1875.			1876.			1877.			1875.			1876.			1877.		
	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom
Maximum	106°	81°	81°	98°	80°	79°	99°	80°	80°	96°	75°	75°	97°	75°	75°	105°	77°	77°
Minimum	71	75	75	75	72	71	80	73	73	72	71	71	73	70	69.50	76	70	70
Mean	92.96	78.83	78.83	87.93	76.40	75.37	91.54	77.22	77.22	88.93	73	73	85.53	72.13	71.30	90.56	73.76	73.76

TEMPERATURE.

Railroad Crossing at Tehama, Sacramento River, latitude 40° 01′ 30″ *N., longitude* 122° 06′ *W.*

	AUGUST.									SEPTEMBER.								
	1875.			1876.			1877.			1875.			1876.			1877.		
	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom
Maximum	104°	78°	78°	100°	74°	74°	100°	76°	76°	99°	70°	70°	98°	70°	70°	104°	72°	72°
Minimum	78	70	70	69	68	68	84	69	69	80	66	66	70	66	66	80	66	66
Mean	95.64	75.51	75.51	91.38	70.61	70.61	93.74	72.90	72.90	90.63	69.60	69.60	87.26	67.66	67.66	91.23	68.73	68.73

TEMPERATURE.

Lower Railroad Crossing, San Joaquin River, latitude 37° 50′ *N., longitude* 121° 22′ *W.*

	August.									September.								
	1875.			1876.			1877.			1875.			1876.			1877.		
	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom
Maximum	98°	82°	81°	97°	79°	78°	95°	81°	81°	94°	78°	78°	93°	75°	75°	102°	78°	78°
Minimum	73	72	71	75	75	74	78	71	71	73	72	72	73	70	69	70	71	71
Mean	88.16	78.67	78.3	86.16	76.93	76.09	89.58	77.87	77.87	85.63	74.08	74.43	83.43	72.56	72.06	87	73.80	73.80

TEMPERATURE.

Upper Railroad Crossing, San Joaquin River, latitude 36° 52′ *N., longitude* 119° 54′ *W.*

	August.									September.								
	1875.			1876.			1877.			1875.			1876.			1877.		
	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom	Air	Water at Surface	Water at Bottom
Maximum	107°	84°	83°	111°	77°	76°	112°	77°	76°	104°	82°	83°	108°	78°	77°	105°	78°	77°
Minimum	82	74	73	81	73	72	90	73	72	82	74	73	80	74	73	76	75	74
Mean	100.61	80.67	79.67	101.09	74.96	73.96	99.64	75.80	74.80	95.53	78.83	77.83	94.00	76.76	75.76	92.96	76.63	75.63

ILLEGAL FISHING.

There is a prevalent opinion throughout the State, that it is the especial duty of the Fish Commissioners to act as local police in each neighborhood and prevent violations of the law in relation to fishing during the close season. Much time is consumed in answering questions on this subject, and informing correspondents by letter that it is the duty of every citizen to see that the law is obeyed. We believe the law which prohibits the catching or having in possession salmon from August first to November first has been more extensively violated during the present year than ever before. It is true the fish are not sold openly in the city markets, but we are informed that the fishermen have erected salting establishments and smokehouses in various by-places on the sloughs between the Sacramento and San Joaquin, where the work of salting and smoking has been prosecuted more extensively than in any previous year. We learned that the canning establishment of Messrs. Emerson Corville & Co., at Collinsville, only made a pretense of ceasing work on the first of August, and that they secretly persisted in violating the law. We caused them to be arrested and fined, upon which they quit work and promised hereafter to obey the law. The canning establishment near Sacramento was also reported as at work during the close season. The proprietors have been indicted by the Grand Jury of Sacramento, and will be fined, if found guilty, during the next term of Court. It is well known that salmon, during the spawning season, are unfit for food. The fish canned, salted, or smoked at this period, if consumed or sold, will have the effect of giving the Sacramento salmon a bad reputation in the market. For this reason the "canners" on the Columbia River cease work on the first of August in their own interest, and without any requirement of law. It is useless for the State to hatch fish and turn them into the river if there is no time in the year when they are permitted to reach their spawning grounds for purposes of reproduction. It would seem that when the State expends money in filling the river with valuable fish for the benefit of the public, and especially for the benefit of fishermen, that there should be sufficient intelligence and public spirit among local officers and the fishermen themselves to see the law obeyed and give the fish an opportunity to keep up the supply. If the Commissioners are to expend the appropriation in prosecuting violations of the law there will be no money to pay for the hatching of additional fish. Many of the fishermen acknowledge the justice and ultimate benefit of an observance of the law, and obey it, but very properly complain that their work ceases, while those who violate it reap a greater benefit.

The following extracts from a letter received by the Commissioners from a fisherman who has followed the business of catching salmon on the Sacramento and San Joaquin for the San Francisco market during twenty years, will illustrate that, at least, the more intelligent and thoughtful of these men acknowledge the necessity of an observance of the law. His letter also gives facts of importance as to the habits of the Sacramento salmon. Writing from Rio Vista, August 17th, 1877, he says: "I understand the 'cannery' has shut down, but the greed for salmon is so great, I would not trust them without watching. As to the fishermen, they will be salting them all along the banks of the Sacramento and Lower San Joaquin (as far up as the mouth of the Mokelumne) unless especial means are taken to prevent it. The Three-mile Slough, leading from one river to the other, around the head of Sherman Island, is also fine fishing ground, and more retired from public observation than any other. Many of the fishermen started off with their tanks, etc., the very day the 'cannery' was reported to have stopped. Many of them are energetic, restless men, and the idea of doing something sly or contrary to law gives zest to their labor. Right here where I write a few boards have been thrown up shed-fashion by a party I need not now name. You may well believe salted salmon will be under it if some stranger does not prevent it. You may rest assured that the people who reside here will not be known as the initial instruments in punishing anyone for the violation of the salmon laws, although there are many who feel it ought to be respected. No doubt, public feeling and practice will occupy about the same status at Collinsville and wherever salmon fishing is a business. As I wrote to you the other day, now (August) is the time to protect the salmon. In review of long experience and observation I opine that of all the salmon passing in the months of August, September and October, more than ninety per cent. pass between August tenth and October first. The seed run is always on time, not being like the spring run, accelerated or retarded by the differing moods of the river, caused by the winter and spring rains. If during the last named period (August tenth to October first) the law were rigidly enforced, you would find seed enough for home use and a good part of all creation beside. Indeed, I think that one month out of the thickest of them, say August twentieth to September twentieth, would be quite sufficient, and therein I differ with you in opinion, no doubt. But you have not, perhaps, observed in person, as I have, the multitudes and urgency of the run at that time; and this is almost uniform—it has not varied in time ten days in twenty years. Now, during the period of four or six weeks, the State, in view of the magnitude of the producing interest involved, ought surely to provide beyond peradventure for the enforcement of the law. The statute names the taking or possession of salmon a crime, but in the public mind this crime is only an illegal act. You cannot force sentiment by act of the Legislature. The absence of sentiment excuses the citizens' apathy, and between ignorance and cupidity the salmon will suffer unless special agents of the State do for the public what the public have not yet quite learned they ought to do for themselves. Strangers are the best agents for this business. Citizens living in a fishing neighborhood do not feel like subjecting themselves to the enmity and revenge of a rough class by complaint. And, again, in this salting business, the criminal acts are beyond observation, except by express intention, as the fish are caught chiefly in the night, and the salteries are usually situated away from public highways and thoroughfares."

We have expended a part of the appropriation in prosecuting offenders against the law, but the field is so large and the profit so great, that but little good has been accomplished. The more fish hatched and placed in the river, the more numerous the fishermen, and the greater, apparently, the desire to make a profit from a violation of the law. As has been stated, unless the fish are allowed, in their season, to reach their spawning grounds, the rivers will be exhausted Until the fishermen realize that the object of the law in creating a close season is the perpetuation and increase of the numbers of fish, the law will continue to be violated. We see no remedy at present except, hereafter, to devote a larger portion of the appropriation in preventing illegal fishing, and in prosecuting offenders against the law. This will require the use of a part of the appropriation which should be devoted to increasing the number of fish placed in the river. If it is expected that the Commission shall employ special means to enforce an observance of the law, and also employ attorneys to prosecute offenders, it is necessary that the appropriation should be increased. It is not now sufficient for these purposes, and also for the hatching of any large quantity of salmon with which to keep pace with increased fishing and the increasing numbers of sea lions. We have consulted with many of the fishermen, and they admit that the law creating a close season should be obeyed, provided all be made to obey it. It is but proper to say, however, that they, at the same time, urge that the close season for salmon (August first to November first) is too long a period. In correspondence with one of these men, who has made a business of fishing for salmon on the Sacramento and San Joaquin for many years past, as to the necessity for an observance of the law, he says: "I do not wish to be known as urging the enforcement of the law, or as a special informer against any party who has violated it. My reasons for this reservation affect alike my own peace and safety and that of many persons whom, I know, have no worse intention than to earn a living and obey the law, provided that others, less honest, are prevented from violating it with impunity. Your idea of a patrol boat, or boats, with officers, is the correct one, and I firmly believe that if, by this or other means, the prohibition were strictly maintained from Benicia upward, wherever there are practical fishing grounds, during the period of one month at the right time, that the perpetuation of salmon in our rivers would be abundantly secured. Between the tenth of August and first of October more than ninety per cent. of the seed run passes, and has not failed to pass, during twenty years of my observation. If the whole of the seed run is not wanted for seed, they ought not to be so used, for the fish is just as good food then as at any other time, only the wastage is something more, the spawn being larger. On the Columbia River I understand that the fall run is almost or quite worthless. Not so on the Sacramento. Well, we may be proud of our river; it is the paradise of the salmon, and they seem determined to resist the devils—who also seem determined to drive them out—better than could be expected; but they will need help in the future. The nets for taking them are being multiplied and improved. The fishing grounds are better known than formerly. Such obstructions as snags in the river bottom are less common—many of them having been broken off or taken up by the nets and put out of the way, or covered by sediment, so that a wider and longer sweep may be taken by the drifting net. Altogether, the salmon is sure to be exterminated, fight he ever so persistently, unless we help him. Surely the State can afford to guard him effectually one month in the year. The cupidity of the fish speculator, who only cares for the greatest number of cases he can pack and ship, should not be allowed to influence the statement of that time. Let it be somewhere between the tenth of August and the first of October. By the way, it seems to me that at the extreme upper waters, on the spawning grounds, the fish should be protected during their entire stay, excepting as needed solely for the purpose of artificial hatching. But of this you are a better judge than I can be."

While not agreeing with this intelligent fisherman as to the propriety of shortening the close season, we fully concur as to the absolute necessity of a patrol to prevent unlawful fishing while the salmon are passing up to their spawning grounds. We also concur in his suggestion that the salmon should be protected on their breeding beds. The most important spawning ground left in this State is the McCloud River, in Shasta County. Its banks are mainly composed of lava and limestone, and, so far as known, they contain no mines. By some inadvertence or intentional manipulation, this county was exempted from the law creating a close season for salmon, and the fish are persistently taken in this county for market, while in the act of reproduction on their spawning beds. We respectfully urge that Shasta County be reincorporated in the law, and that no salmon be allowed to be taken there during the close season, except for purposes of artificial propagation.

The Chinese and others continue to use nets of a mesh much finer than is allowed by law, and the young of all kinds of salt water fish that spawn in the bays and estuaries, are persistently caught, dried, and shipped to China. The records of the Custom House show that there were shipped to China, from San Francisco, during the year ending July first, eighteen hundred and seventy-seven, dried fish and dried shell fish valued at two hundred and ninety-three thousand nine hundred and seventy-one dollars.

We have caused several arrests to be made for violations of this law, but it is impossible for the Commissioners to act as local police on all parts of the bay and rivers, and we see no remedy except in increasing the penalties for violations of the law, involving even, if necessary, the destruction of the nets, when used out of season. Unless in some way the wise provisions of the statute are compelled to be observed, we can see no reason why our present abundance of fish will not decrease, as they have decreased in other States, in consequence of the disregard of wise enactments made for their preservation and increase. Ordinarily salmon should reach their spawning grounds on the McCloud and Little Sacramento by the twentieth of August. As will be seen by the statistics heretofore stated, the catch was never so great as during the past fishing season. At the commencement of the close season, August first, the river was filled with fish, yet they were not permitted to reach their spawning places. Mr. Myron Green, the deputy in charge of the United States fish hatching establishment on the McCloud, reported, September fifteenth, that there were ten salmon in the McCloud in eighteen hundred and seventy-six to one in eighteen hundred and seventy-seven. Up to that time but five million eggs had been taken, while nearly ten million had been taken in a corresponding period in eighteen hundred and seventy-six. The fish were in the Lower Sacramento more numerous than ever before, but they were caught, canned, salted, and smoked, in defiance of the law. It is estimated that the "canneries" took fifty thousand after the first of August, and that there were salted and smoked on the banks of the sloughs and other by-places, at least one hundred thousand more. If this is to continue, the Government hatching works will have to be removed to the Columbia, and we will be compelled to import eggs from some other State, even to keep up a partial supply of salmon in the Sacramento River.

In addition to making the penalties more severe for violations of the law, we would recommend that the law be so amended that it shall be made a misdemeanor to fish for salmon with nets or traps between sunset on Saturday and sunrise on Monday of each week. This would give the salmon the freedom of the river one day in the week, do no injury to the fishermen, and go far towards continuing the supply in our rivers.

SHAD (ALOSA PRÆSTABILIS).

Shad, in their season, are becoming quite numerous in the Sacramento River. The experiment of their importation to this coast has resulted satisfactorily. The river is of proper temperature, and furnishes an abundance of food for the young fish before they go to the ocean. There can be no doubt that the first shad brought from the Hudson River in eighteen hundred and seventy-one have been to the ocean, returned and spawned. No shad were placed in the river during the years eighteen hundred and seventy-four and eighteen hundred and seventy-five, yet shad two years old were quite numerous this year, and they must have been the product of the first importation. It may be safely asserted that we now have shad born in the Sacramento. As it is illegal to take this fish prior to December of this year, probably there has been no systematic fishing for them, yet numbers have been accidentally caught in traps and nets; probably not less than one thousand were thus taken during the winter and spring of eighteen hundred and seventy-seven. They return from the ocean at an earlier season of the year than in the northern Atlantic States, in this respect corresponding to the periods when they return to the rivers of South Carolina and Georgia. The first reported this year were taken in Sonoma Creek, January sixth; the latest, two at Sacramento, June twentieth. These latter were full grown fish, a male and female, on their return to the ocean after having visited their spawning grounds. There were placed in the Sacramento River, at Tehama, in eighteen hundred and seventy-one, fifteen thousand young shad; in eighteen hundred and seventy-three, thirty-five thousand; in eighteen hundred and seventy-six one hundred and twenty thousand, and in eighteen hundred and seventy-seven one hundred and fifteen thousand—in all, up to the present time, two hundred and eighty-five thousand. All of these were donations from the United States Government, but in some cases we have paid all, and in others a part of the cost of transportation. We hoped during the past summer to import at least three hundred thousand, and had all the arrangements made for this purpose, but failed in consequence of the "railroad strikes," which unfortunately took place at the time the young shad were ready for shipment. We are frequently urged to make larger importations of shad, and fill the rivers immediately. This is impossible with the appropriation at our disposal. The eggs of the shad, after being taken, are hatched in from twenty-four to forty-eight hours, while floating in the water, and the young almost immediately require food. From the Hudson to California in seven days, is the greatest distance and longest time that young shad have yet been transported. With the utmost care and attention it is doubtful if they could be kept alive another day. We can, therefore, only receive in one shipment the eggs of the fish that can be caught in one night's fishing. This rarely exceeds one hundred thousand. As the cost of the passages of the necessary attendants from the Atlantic and their return, with express charges, etc., equals twelve hundred dollars, we have not felt authorized to make more than one importation a year. We believe, however, that by eighteen hundred and seventy-eight shad will be sufficiently numerous in the Sacramento to warrant the attempt at taking ripe fish for the purpose of artificial hatching in our own waters. Should we be successful, we can save the expense and risk of importation, and all our appropriate rivers can, in a few years, be filled with this valuable fish. Having this in view, we would respectfully ask that you recommend the passage of a law restricting the catching of shad at all other times except between January first and April first, of each year. This, if faithfully observed, would give a part of the fish an opportunity to reach their spawning places.

It is well known that salmon, after going to the ocean, invariably return to the river of their birth for purposes of reproduction, and this was supposed to be the instinct of the shad, yet we have information of a shad having been taken at Wilmington, and others in Russian River and in the Columbia, points on the coast separated by more than four hundred miles. It may be possible that as these fish become more numerous they will return in schools to the Sacramento, the young following their elders who have once made the journey. Should they continue to enter different rivers on their return from the ocean they will soon stock all on the coast that are appropriate to them.

WHITEFISH (COREGONAS ALBA).

In January last we received from the United States Fish Commissioner a donation of three hundred thousand eggs of the whitefish. These were successfully hatched under the superintendence of Mr. J. G. Woodbury, at the State hatching house at Berkeley, and the young fish were distributed as follows: Seventy-five thousand in Donner Lake; fifty thousand in Sereno and other lakes near the Summit, in Placer County; and one hundred and seventy-five thousand in Lake Tahoe. Including twenty-five thousand placed in Clear Lake in eighteen hundred and seventy-three, and twenty-five thousand in Tulare Lake in eighteen hundred and seventy-five, there have been planted in the waters of this State three hundred and fifty thousand of these valuable food fish. We believe they have lived in Clear Lake, also in Tulare. It was reported in a Lake County paper, that a whitefish was taken in Clear Lake April tenth, eighteen hundred and seventy-six, which measured a foot in length. We have no positive information that they have found a congenial home in Tulare Lake, but have heard reports that a few have been seen. As these fish can only be taken with a net, and as these are rarely used on these lakes, their waters will have an opportunity to become fully stocked before they are extensively fished. There can hardly be any doubt but they will succeed in Tahoe and other lakes near the summit of the Sierra—the climate, water, and food being not dissimilar to those of Lakes Michigan, Huron, and Superior, in which they are indigenous. These fish live upon small crustacea, found on the rocky and gravel bottoms of lakes. They grow to weigh an average of one and a half pounds, and constitute the most important food fish of the people living near the great lakes. Professor Baird, in his report to Congress, says: "Few fishes of North America will better repay efforts for their multiplication." We are promised a further supply of eggs during the present winter, and shall continue receiving eggs, and hatching and distributing these fish to all the mountain lakes that are accessible during the winter months.

CATFISH (PIMELODUS CATTUS).

The seventy-four Schuykill catfish imported in eighteen hundred and seventy-four, and placed in lakes near Sacramento, have increased to a vast extent. They already furnish an important addition to the fish food supply of the City of Sacramento and vicinity. From the increase we have distributed eight thousand four hundred to appropriate waters, in the Counties of Napa, Monterey, Los Angeles, Fresno, Tulare, Santa Cruz, Shasta, Solano, Alameda, San Diego, Yolo, Santa Barbara, and Siskiyou. These, should they thrive and increase as they have in Sacramento, will furnish an abundance of valuable food in the warm waters of the lakes and sloughs of the interior, and replace the bony and worthless chubs and suckers that now inhabit these places. It may be proper to call attention to the fact that these fish have become so numerous in the lakes near Sacramento that they can now be obtained in any quantity for stocking other appropriate waters in any part of the State.

CARP.

In exchange for California trout eggs sent to the Department of Agriculture of Japan, we received, in May last, eighty-eight Japanese carp. These were all young fish. We have had them placed in the aquarium, at Woodward's Garden, where they are regularly fed and cared for. When they shall have arrived at maturity they will be placed in some appropriate lake or slough in the interior, and their increase will be used to stock the warm waters of our valleys. Mr. Sekizawa Akeiko, of the Agricultural Department of Japan, in writing to us of these fish, says: "They grow very fast. In three years they may be a foot and a half in length. We consider them one of the best fish in fresh water."

Professor Baird, United States Fish Commissioner, imported from the headwaters of the Danube a number of the king carp. These are now breeding in ponds at Druid Hill, near Baltimore. The increase will be ready for distribution during the coming summer. We are promised a large consignment. The king carp is considered the most valuable and delicately flavored food fish of the carp family. These and the Japanese carp, when they can be distributed to all the sloughs, reservoirs, and lakes of the interior, will furnish a valuable increase of fish food. They will be a very excellent substitute for the worthless and unpalatable fish of the warm waters of the great valleys in the interior of the State.

AWA (CHANOS CYPRINELLA) AND MULLET.

In exchange for some salmon and trout eggs, sent to the Hawaiian Islands, we received, in July last, nearly one hundred fish called "awa." These we placed in a small stream at Bridgeport, in Solano County, where they could have free access to brackish and salt water. They are said to be the most valuable food fish of the Hawaiian Islands, of fine flavor, and thrive in fresh, brackish, and salt water. Where they have access to salt water, they grow to weigh an average of five pounds. We have reason to believe they will find congenial homes, and grow and multiply in the waters of this State. In December, we are promised a consignment of the Hawaiian Islands mullet, said to be a superior food fish, which also lives equally well in fresh or salt water.

TROUT.

In January, eighteen hundred and seventy-seven, we purchased one hundred and thirty-three thousand Eastern trout eggs (*salmo fontinalis*), which were received in good condition, and hatched at the State hatching house, at Berkeley. We also purchased forty-five thousand eggs of the McCloud River trout (*salmo irridea*), which were hatched at the same place. The former we caused to be distributed in proper streams in Siskiyou, Contra Costa, Alameda, Placer, Nevada, Santa Cruz, San Mateo, Monterey, Los Angeles, San Diego, Yuba, and Santa Clara Counties. The latter in streams in Tulare, Placer, Sonoma, Mendocino, Santa Clara, and Monterey Counties. The McCloud River trout is a valuable fish, of fine flavor, and, often reaching four pounds in weight. It grows more rapidly than any other trout with which we are acquainted. No more valuable variety of trout could be distributed. So many of our streams have been depleted of trout by mining, sawdust, and illegal fishing, that more should be done towards restocking them. But the salmon has so much commercial value, and gives employment to so many people, that we have felt it to be necessary to devote the greater part of the appropriation to keeping up the supply of this fish.

BLACK BASS, EELS, AND LOBSTERS, ETC.

The black bass placed in Napa and Alameda Creeks have increased; many have been caught, and by June, eighteen hundred and seventy-eight, the young can be planted in other appropriate streams. It is said that a few eels have been caught, but they have not become numerous. We hear reports of a few lobsters having been taken in the Bay of San Francisco, near Redwood, but none have as yet been brought to us for identification. It is also reported that tautog have been seen in the market of San Francisco. A majority of the varieties of fish imported from the Atlantic States have become acclimated, and are increasing in our waters. If any portion of the appropriation can be spared from the hatching of salmon, we will make another attempt at the importation of a car load of lobsters and eels. Sufficient experience has now been had to insure success in bringing lobsters alive across the continent. Could they be successfully introduced in quantities into the waters of the Pacific Coast they would be a valuable acquisition to our food supply.

HATCHING-HOUSE.

We find the State hatching-house, at Berkeley, to be too small for the quantities of fish required to be hatched. In addition, the supply of water is uncertain and unreliable. During the last spring the State nearly suffered a serious loss of young fish in consequence of the failure of water. We are under obligations to Mr. Chabot, of the San Leandro Water Works, for facilities afforded us in this emergency, and to our Foreman, Mr. J. G. Woodbury, for his ready resources and untiring energy in saving the young fish then in the hatching troughs. Should the Legislature make the necessary appropriation, we deem it advisable to procure a proper location with an abundant supply of water on which to erect a larger State hatching-house.

LEGISLATIVE COMMITTEES.

We would urge that the fishery interests of this State are so important, and are increasing so rapidly, that at each session, the Legislature will be importuned to make changes in the laws which regulate this industry. It appears to be, therefore, necessary that each House should now have a standing committee on fisheries. Such committees could take testimony which would be valuable, and they could then prepare intelligent and enlightened legislation, which would have the effect of continuing and increasing the supply of food fish in our waters. Other coast States have found this to be not only necessary but profitable.

RECEIPTS AND EXPENDITURES.

The following is an account of the receipts and expenditures since the last report:

RECEIPTS.

August 4, 1875—By cash on hand last report	$1,295 42
February 9, 1877—By cash appropriation for fiscal year	5,000 00
January 6, 1877—By cash returned, express on salmon eggs for New Zealand	11 50
February 7, 1877—By cash returned, express on salmon eggs for New Zealand	13 00
May 31, 1877—By cash returned, Sportman's Club	2 25
July 10, 1877—By cash appropriation for fiscal year	5,000 00
	$11,322 17

EXPENDITURES.

October 7, 1875—To expenses, 250,000 salmon eggs to Kern River	$51 00	
October 7, 1875—To telegram to Bakersfield	1 00	
October 10, 1875—To Myron Green, balance expenses to Kern River	69 51	
December 10, 1875—To W. Bassett, expense transporting catfish	10 00	
January 11, 1876—To W. F. Hubbard, labor salmon hatching on Truckee	150 00	
January 11, 1876—To telegram to L. Stone	1 12	
February 8, 1876—To A. Preece, copying report for State Printer	50 00	
February 8, 1876—To discount on sale of silver	6 25	
February 8, 1876—To L. Stone, on account purchase of trout eggs	111 25	
February 8, 1876—To W. F. Hubbard, balance in full hatching salmon eggs	279 25	
February 8, 1876—To expressage on salmon trays to Redding	3 00	
February 8, 1876—To L. Stone, balance in full on trout eggs	87 52	
March 17, 1876—To J. G. Woodbury, transporting trout to Lake and Napa Counties	82 35	
March 22, 1876—To express and telegram	1 15	
March 29, 1876—To expenses incurred by J. D. Farwell	53 36	
Carried forward	$956 76	$11,322 17

Brought forward	$956 76	$11,322 17
July 8, 1876—To drayage and freight on air pump for shad	38 80	
July 27, 1876—To telegram to Holyoke, Mass., on shad	13 60	
August 8, 1876—To labor and ice for shad at Sacramento	4 75	
August 10, 1876—To Wells, Fargo & Co., expressage on shad from Holyoke, Mass.	146 60	
August 12, 1876—To fare and expenses of Clark and Bean with shad	421 44	
August 12, 1876—To return fare of Clark and Bean to Washington	228 60	
October 18, 1876—To prosecutions under salmon law, freight, telegram, etc.	46 75	
December 12, 1876—To David Griffin, labor and care trout	50 00	
January 4, 1877—To telegrams December 12th, 22d, and January 4th	7 65	
January 4, 1877—To express on whitefish eggs from Michigan	23 00	
January 4, 1877—To wire cloth and repairs to hatching house	45 35	
January 4, 1877—To express on trout eggs from New Hampshire	39 67	
January 9, 1877—To wire cloth, fares of Woodbury, and telegrams to New Hampshire	27 32	
January 10, 1877—To telegram to Michigan, etc., wire cloth	4 85	
January 15, 1877—To Woodbury, one month's salary, hatching	150 00	
January 17, 1877—To express on whitefish eggs from Michigan, drayage and telegram	27 64	
January 23, 1877—To Ellis, one month's labor, $60, express on trout eggs from New Hampshire, etc.	105 50	
January 24, 1877—To Livingston Stone, on account of transportation of lobsters	142 50	
January 27, 1877—To Expense of transporting whitefish to Donner Lake	30 00	
February 5, 1877—To carpenter work on hatching house, freight, etc.,	53 55	
February 9, 1877—To Livingston Stone, hatching 1,500,000 salmon	1,500 00	
February 19, 877—To express on trout eggs, New Hampshire, and telegram	27 05	
February 12, 1877—To express on land-locked salmon eggs, Maine, and telegrams	16 15	
February 14, 1877—To transporting whitefish to Tahoe, Capital Savings Bank advanced	98 11	
February 28, 1877—To freight, cans, transporting trout, and telegram	7 65	
February 28, 1877—To Woodbury, salary, $150; Ellis, labor, $60; and transporting fish, etc.	258 70	
March 5, 1877—To Stone and Hooper, 133,400 trout eggs, New Hampshire	481 71	
March 5, 1877—To transporting trout to South Yuba and American, etc.	22 32	
March 19, 1877—To Woodbury, salary one month	150 00	
March 26, 1877—To transporting trout and whitefish, etc.	47 20	
March 26, 1877—To iron pipe for hatching house, express, and telegrams	101 72	
March 28, 1877—To Seth Green, balance due, $50 50; Ellis, one month's labor, $60	110 50	
March 28, 1877—To express, etc., on cans and fish	6 04	
March 28, 1877—To ice used in transporting fish	32 95	
April 13, 1877—To Ellis, six days' labor, $12; express and telegrams, $8 90	20 90	
April 15, 1877—To Woodbury, salary $150, and freight on eggs and fish, $23 75	173 50	
April 23, 1877—To fish to Russian River, cartage, etc.	14 70	
April 27, 1877—To expense of trout to North Fork of American River	10 75	
May 1, 1877—To fourteen days' labor to Dunn, and freight on distributing fish	82 15	
May 28, 1877—To express charges and labor	33 10	
May 30, 1877—Importation of carp from Japan	30 00	
May 31, 1877—To Woodbury, two weeks' services and telegram	75 80	
June 23, 1877—To expenses, fares, and labor on shad, Sacramento and Tehama	96 00	
July 10, 1877—To discount on silver	27 50	
July 12, 1877—To Clark and assistants, shad at Tehama, ice and telegram	79 55	
July 17, 1877—To Whittier, catching and distributing catfish	41 25	
July 20, 1877—To Green, 45,000 McCloud trout eggs, etc.	182 00	
July 27, 1877—To expenses, importation and distribution of fish, Honolulu	25 50	
Carried forward	$9,317 13	$11,322 17

Brought forward	$ 9,317 13	$11,322 17
July 31, 1877—To purchase twenty cans for transporting fish	100 00	
August 14, 1877—To catching and distributing 1,000 catfish	83 00	
August 16, 1877—To H. D. Dunn, prosecution violations of salmon law	100 00	
August 31, 1877—To N. Lovely, two weeks' labor	25 65	
September 8, 1877—To N. Lovely and assistant, one week	28 00	
September 9, 1877—To Henry Pitzer, catching and distributing 7,000 catfish	50 00	
September 21, 1877—To Lovely and Bradley, ten days work at Collinsville	43 00	
October 3, 1877—To Young, gathering statistics	40 00	
October 3, 1877—To fares and expenses of witnesses, People vs. Corville	54 38	
October 6, 1877—To Flynn, twenty days, witness, People vs. Corville, and express	52 50	
October 6, 1877—To Cowdery & Preston, People vs. Labella, Garibaldi & Corville	242 75	
October 11, 1877—To Kimber and Whittier, catfish for Siskiyou, and ice	55 63	
October 19, 1877—To fees of Sheriff of San Joaquin, serving notices	2 60	
October 19, 1877—To Purser Australia, care of fish	2 50	
October 29, 1877—To United States, on account hatching salmon	500 00	
November 2, 1877—To freight, fish cans, and cartage	1 25	
November 8, 1877—To J. D. Farwell, bill transporting trout, Alameda	10 65	
November 16, 1877—To H. C. Marks, copying report	50 00	
November 16, 1877—Amount on hand to balance	3,563 13	
	$11, 322 17	$11,322 17

This balance of three thousand five hundred and sixty-three dollars and thirteen cents will be consumed in payments to become due for the salmon now hatching on McCloud River, and in the expense to be incurred in the hatching of white fish eggs, and other fish eggs promised to be donated by the United States during the present winter.

All of which is respectfully submitted.

B. B. REDDING,
S. R. THROCKMORTON,
J. D. FARWELL,
Commissioners of Fisheries.

SAN FRANCISCO, CAL., November 10, 1877.

COMMISSIONERS OF FISHERIES.

UNITED STATES.

Spencer F. Baird	Washington, D. C.

ARKANSAS.

N. H. Fish	Pine Bluffs.
J. R. Steelman	Little Rock.
N. B. Pearce	Fayetteville.

CALIFORNIA.

S. R. Throckmorton	San Francisco.
B. B. Redding	San Francisco.
J. D. Farwell	San Francisco.

CONNECTICUT.

William M. Hudson	Hartford.
Robert G. Pike	Middletown.
James A. Bill	Lyme.

GEORGIA.

Thomas P. James	

(Duties embracing the work of the fish interest assigned to Commissioner of Agriculture.)

IOWA.

Samuel B. Evans	Ottumwa.
B. F. Shaw	Anamora.
Charles A. Haynes	Waterloo.

KENTUCKY.

Pack Thomas	Louisville.

MAINE.

E. M. Stillwell	Bangor.
Henry O. Stanfield	Dixfield

MARYLAND.

T. B. Ferguson	Baltimore.
T. W. Downes	Denton.

MASSACHUSETTS.

Theodore Lyman	Brookline.
Asa French	South Braintree.
E. A. Brackett	Winchester.

MICHIGAN.

George Clark	Ecorse.
A. J. Kellogg	Allegan.
E. R. Miller	Richland.

MINNESOTA.

R. O. Sweeney	St. Paul.
Robert Owesly	
William Golcher	

NEW HAMPSHIRE.

Colonel Samuel Webber	Manchester.
Albina H. Powers	Grantham.
Luther H. Hayes	Milton.

NEW YORK.

Horatio Seymour	Utica.
Robert R. Roosevelt	New York City.
Edward M. Smitts	Rochester.

NEW JERSEY.

B. P. Howell	Woodbury.
J. R. Shortwell	Rahway.
G. A. Anderson	Trenton.
George Ricardo	Hackensack.

OHIO.

John C. Fisher	Coshocton.
John H. Klipput	Columbus.
Robert Cummings	Toledo.

PENNSYLVANIA.

J. H. Reeder	Easton.
B. L. Hewett	Hollidaysburg.
James Duffy	Marietta.

RHODE ISLAND.

Newton Dexter	Providence.
Alfred A. Reed, Jr.	Providence.
John H. Barden	Scituate.

UTAH TERRITORY.

A. P. Rockwood	Salt Lake City.

(Superintendent of Fisheries, Zion's Co-operative Society.)

VERMONT.

M. C. Edmunds	Weston.
M. Goldsmith	Rutland.

VIRGINIA.

A. Moseley	Richmond.
W. B. Robertson	Lynchburg.
M. G. Ellyzer	Blacksburg.

WISCONSIN.

William Welch	Madison.
A. Palmer	Bescobel.
P. R. Hoy	Racine.

DOMINION OF CANADA.

W. F. Whitcher	Ottawa.
W. H. Vining	St. John's, N. B.

(Inspector of Fisheries for New Brunswick and Nova Scotia.)

REPORT

OF THE

COMMISSIONERS OF FISHERIES

OF THE

STATE OF CALIFORNIA

FOR

THE YEARS 1878 AND 1879.

1r

MAR 24 1941

[illegible]

REPORT.

To His Excellency, William Irwin, Governor of California:

The Commissioners of Fisheries for the State of California, appointed under an Act of the Legislature, entitled "An Act to provide for the restoration and preservation of fish in the waters of the State," approved April 2d, 1870, respectfully submit their fifth biennial report.

We have to report an increasing public interest in fish culture and in the efforts of your Commissioners to continue the supply of valuable food fish in our waters. The destruction of fish during their seasons of reproduction, in defiance of law, once thought to be but a venial legal offense, is beginning to be considered a serious crime. As population increases, and railroads and other means of transportation are extended, there is a larger demand for fish; this is met by an increase in the numbers of fishermen, by extending the area of the fishing grounds, and by improved processes of capture.

SALMON (ONCORHYNCHUS QUINNAT).

One-half of the annual appropriation placed at the disposal of your Commissioners is expended in the hatching of salmon eggs and placing the young fry in the tributaries of the Sacramento River. From the organization of your Commission, and including the year 1879, we have had hatched and turned into the Sacramento River 13,150,000 young salmon; these, added to the natural supply, have been sufficient to make them as numerous in the river, during their seasons, as they have been at any time since so large an area of their spawning beds was destroyed by the operations of mining. Since our last report three additional establishments for the canning of salmon have been in operation on the Sacramento. If these establishments are to increase in numbers, with the consequent increase in the numbers of fishermen, boats, and nets, the supply of salmon cannot be kept up unless we add to the 2,500,000 of young salmon now annually placed in the river. To do this the appropriation must be increased, or we must abandon all other efforts at adding to the food fish of the State, and expend the whole appropriation in increasing the numbers of salmon. This last course would be unjust to large, important, and increasing interests in the State, and would be a violation of the intent of the law in creating the Commission. If there could be a faithful observance of the law that prohibits the catching of salmon during the close season; if the fish could have the river free from nets during these six weeks, and be allowed in peace to reach their spawning grounds, there would be no necessity for an increased appropriation, even if canning establishments were doubled and fishermen multiplied in the same proportion. During the close season, August 1st to September 15th, no salmon were pub-

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licly exposed for sale in the markets, and outwardly the law seemed to be observed, but we have reason to believe they were caught and privately brought to San Francisco at night, and were served at hotels and restaurants to all who would call for them. The canning establishments ceased to purchase and tin salmon on the 1st of August, and, so far as we are advised, faithfully observed the law, but it is reported that many of the fishermen did not stop netting, and that more than one hundred tons of salt were sold in San Francisco about the 1st of August and shipped to by-places on the sloughs and islands of the Sacramento and San Joaquin, to be used in salting salmon during the close season. This illegal fishing is done at night, and the fish are taken before daylight to temporary shanties for salting and smoking, hidden in the wilderness of sloughs and tule islands. We have no means to prevent this violation of the law, and find but little disposition to assist on the part of the Justices of the Peace and Constables in the vicinity, who hold office by the votes of the men who violate the law.

The close season is now too short. Salmon in large numbers, with eggs fully matured, were on sale in the San Francisco and other markets from September 15th to the 1st of October, and yet we learn efforts will be made at the coming session of the Legislature to still further reduce it, or to change it to a time when there are no fish coming in from the ocean, or perhaps to completely abolish it. Experience in all the other States has demonstrated that fishermen as a class look only to their present profit, and are not willing to yield anything that the supply of fish in the river may be maintained.

The annual hatching of 2,500,000 of young salmon, and their distribution in the sources of the Sacramento, appear to keep the supply in the river equal to that of former years notwithstanding the increase in the number of sea lions protected by law, the increase in the nets and fishermen, and the erection of additional canning establishments.

The following table will show the relative catch for the years during which we have caused statistics to be obtained:

SALMON CAUGHT IN THE SACRAMENTO AND SAN JOAQUIN AND TRANSPORTED TO SAN FRANCISCO, SACRAMENTO, AND STOCKTON.

Open season November 1st, 1874, to August 1st, 1875	5,098,781 pounds.
Open season November 1st, 1875, to August 1st, 1876	5,311,423 pounds.
Open season November 1st, 1876, to August 1st, 1877	6,493,563 pounds.
Open season September 15th, 1877, to August 1st, 1878	6,520,768 pounds.
Open season September 15th, 1878, to August 1st, 1879	4,432,250 pounds.

The apparent falling off in the season of 1878–9 was not because the fish were not as numerous in the river as in former years, but in consequence of a dispute between the proprietors of the canning establishments and the fishermen as to the price to be paid by the former for the fish as they were caught. This dispute continued for some weeks during the height of the fishing season. The canning establishments stopped work, the fishermen formed an association and limited the catch to salmon for the supply of the San Francisco market. During this period but few fish were taken. The catch was, however, in excess of the requirements of San Francisco, and while the fishermen refused to sell average salmon on the fishing grounds to the canning establishments at twenty-five cents each, they forwarded them fifty miles to San Francisco and sold them for twenty-five cents and less. For a month the choicest salmon, weighing from sixteen to thirty pounds, could be bought from fishing boats at the

San Francisco wharves for one cent per pound. The dispute between the fishermen and the canning establishments, by which the river was practically open to the free run of the fish for nearly a month, will have one beneficial effect. It is equivalent to an increase in the length of the close season during the present year. The effect was soon observed on the McCloud and upper Sacramento. The spawning grounds were early filled with fish in greater numbers than ever before observed. The fish were so numerous in the McCloud before the fishermen renewed work on the lower Sacramento that in the pool at the United States Fishery, Mr. Livingston Stone, Deputy United States Fish Commissioner, estimated that in one haul of the seine he captured over two thousand salmon. From this dispute, resulting in an open river during the hight of the run, thus allowing the fish to reach their spawning grounds, it is safe to predict an extraordinary run of salmon in the river in the season of 1883 and 1884.

The following report, made by Mr. H. D. Dunn, whom we employed to see if the law was obeyed during the close season on the Sacramento, and also to obtain statistics of the canning establishments, gives many facts of much importance. His statistics of the money invested in canning establishments on the Pacific Coast, and the number of cases put up during the past year, have much commercial interest. In his report he states:

In accordance with your directions, I visited Collinsville, Rio Vista, and Washington, on the Sacramento River, to inquire if there were violations of the close season for salmon, and to procure statistics of the quantities of that fish canned in 1878 and in 1879, up to the first of August. I have also collected all the data available of salmon canned in other portions of the State, and what amounts were put up in Oregon, British Columbia, and Alaska during the period named. With the single exception of the cannery located at Skeena River, British Columbia, I have obtained authoritative statictics, and herewith hand you statement of the same. The product of this cannery is mostly shipped to Great Britain via Victoria, Vancouver's Island, a small portion only of the catch of 1878 having been shipped in bond via San Francisco.

Owing to unfavorable circumstances, canning of salmon in California has this year been much less than during the same time in 1878. The spring run of salmon in the Sacramento came unusually early, commencing April 1st. The fishermen along the lower part of the river formed a combination, demanding forty cents per fish; the canneries offering twenty-five cents, as being all they could afford. The combination fishermen (mostly Greeks and Italians), by threats, and, in some instances, actual violence, prevented the delivery of any salmon from other boats at Collinsville and Chipps' Island canneries. The latter, however, obtained an insufficient and irregular supply of salmon by steamers from Rio Vista, which was subsequently much interfered with through the same means used in the vicinity of the canneries. Later the fishermen accepted the terms of the canners, and supplied fish; but the run ceased a few days later, the canneries closing June 6th. While the canneries at Collinsville and Chipps' Island were idle from want of fish, the cannery at Washington, Yolo County, procured a sufficiency at a less price than was refused by the lower river fishermen.

Being debarred supplying salmon to the Chipps' Island cannery, the fishermen (Germans), between Benicia and Montezuma Slough (a distance of 13 miles), made arrangements with a canning firm in San Francisco to put up and sell their catch, the total being about 6,000 cases. This firm expect to can more salmon this year, should the fall run (after September 15th) be sufficient, and, if the outlook is favorable, will continue in the business hereafter. The spring run of salmon in 1879 is reported as averaging twelve pounds per fish, dressed for canning. The market price for one pound salmon tins has been lower this year than before known—the ruling rates being $1 05 @ $1 10 per dozen.

Canners complain that the season for taking salmon is too short to admit of their doing a profitable business, and, that from the same cause, the fishermen cannot make a fair living and respect the law, without charging a higher price for fish than canners can pay and successfully compete with the put up of the Columbia River canners. They claim that, under the present law, the catch of salmon for canning purposes, does not last longer than six weeks on the Sacramento River, while it is fully four months on the Columbia River; that they have to prepare a full stock of cans in advance of the season's catch, and are put to many expenses for an entire year for not over six weeks' active work; that the spring run of salmon is irregular in times of arrival, varying as much as six weeks in different years. The spring run for canning in 1878 commenced May 15th, while this year there was a sufficient supply on March 29th to commence on.

While the canneries were idle in April, this year, large quantities of salmon were caught and sent to the markets in San Francisco, where they were sold in part at about freight charges, a great many spoiling and being thrown into the bay as unfit for any use. Adult salmon in large quantities are reported as sold in April, in this city, at from 3½ to 6 cents each, the price rising May 1st to 15 and 20 cents each.

I have to report that, when at Collinsville on the 15th of August, I saw many salmon breaking in the river, and was informed by a Mr. W. Hosking, that at least 100 fish could be taken by a boat in making one drift of its net. From other parties I received information of violations of the close season, and while there I saw boats with nets going up the river to fish. Since my return I have seen letters from reputable persons, stating there were at least fifty boats out taking salmon in defiance of the law, and that one boat, containing 140 salmon, came to the wharf at Collinsville on 19th of August. The fish thus taken in defiance of law are mostly salted and smoked by the fishermen in the tules, a few probably being sent in a fresh state surreptitiously to this city. While on this subject, I desire to state my belief, that the Mr. Hosking referred to above is knowing to the continued violation of the salmon law, and from the circumstances of his position does much to encourage the same. He openly denounces the present law, keeps the only store at Collinsville, and does a large trade with the fishermen, who are more or less in his debt. He is Postmaster, Justice of the Peace, express agent, wharf keeper, and telegraph operator; so that all communications by letter or telegraph have to pass through his hands. The support of the citizens of Collinsville being largely derived from the salmon fishery, it would be difficult, if not impossible, to convict persons accused of violating the law under the circumstances stated.

COST OF CANNERIES IN CALIFORNIA.

Eight canneries, about $25,000 each	$200,000 00
Two hundred and twenty boats, about $325 each	72,500 00
Two hundred and twenty nets, 250 fathoms each, $300 each	66,000 00
One hundred and twenty scow-houses for men on the Sacramento River, about $300 each	36,000 00
Total value of fixtures, etc.	$374,500 00

No estimate is made for the boats and nets used at the canneries at Eel and Smith's Rivers.

Number of men employed in fishing, about 600.

Number of men employed in canneries, about 800.

Boats are 22 feet long, 6½ feet beam, and 2 feet 6 inches deep; are sharp at both ends, have two lockers amidship to contain the fish, and have a large triangular sail.

The fishermen are all whites.

The can-makers are all whites.

The other workmen are all Chinese.

The catch of salmon in Smith's and Eel Rivers take place in September and October. The cannery at the latter place will not put up any salmon this year, owing to low prices ruling for such products.

STATEMENT OF SALMON CANNED IN CALIFORNIA IN 1878.

Two canneries at Collinsville, Solano County; one cannery at Chipp's Island, Solano County; one cannery at Rio Vista, Solano County; one cannery at Black Diamond Landing, Contra Costa County—total amount canned—cases	33,000
One cannery, Washington, Yolo County—cases	1,017
One cannery, Eel River, Mendocino County—cases	10,500
One cannery, Smith's River, Del Norte County—cases	4,277
Eight canneries—total cases, 4 dozen 1-℔ cans	48,794

Average size of salmon dressed for canning, eleven pounds. The total number canned, about 222,000. Average value, $5 40 per case, or $263,487.

IN EIGHTEEN HUNDRED AND SEVENTY-NINE.

One cannery at Collinsville, Solano County—cases	588
One cannery at Chipp's Island, Solano County—cases	4,000
One cannery at Washington, Yolo County—cases	3,267
One cannery at San Francisco—cases	6,000
Four canneries—total cases	13,855

Number of salmon, about 67,523; average value, $4 30 per case, or $59,576.

The canning at Eel River will be closed this year. All the other canneries (except Rio Vista, which has been discontinued) will probably resume canning this year, if the fall run of fish should prove good.

COST OF CANNERIES, ETC., IN OREGON.

Thirty-five canneries, about $25,000 each	$875,000
Eight hundred boats in the Columbia River, $325 each	260,000
Eight hundred nets in the Columbia River, $300 each	240,000
Total	$1,375,000

Nets in the Columbia River are about three hundred fathoms each. Number of boats, at five canneries not on the Columbia River, not known. Some of the canneries employ small steamers to collect salmon from the boats. Some few of the canneries on the Columbia River have cost from $50,000 to $60,000 each. About six thousand persons are employed in the canneries and fishing boats in Oregon, two-thirds of whom are Chinese. Average size of salmon when dressed for canning, fifteen pounds. The run of salmon in Oregon, except on the Columbia River, does not commence until August, and the catch at those places will not be known until late in the year.

STATEMENT OF SALMON CANNED IN OREGON, BRITISH COLUMBIA, AND ALASKA, IN EIGHTEEN HUNDRED AND SEVENTY-EIGHT.

One cannery at Sitka, Alaska—cases	2,750
One cannery at Prince of Wales Island, Alaska—cases	5,000
One cannery at Skeena River, British Columbia—cases	Unknown.
Seven canneries at Fraser River, British Columbia—cases	120,000
One cannery at Puget Sound, Washington Territory—cases	Closed.
One cannery at Gray's Harbor, Washington Territory—cases	5,420
Thirty canneries at Columbia River, Oregon—cases	445,000
Two canneries at Sinslaw River, Oregon—cases	10,300
Two canneries at Umpqua River, Oregon—cases	8,100
One cannery at Rogue River, Oregon—cases	8,000
Forty-seven canneries—total cases	604,570

Average value, $5 40 per case, or $3,264,578.

IN EIGHTEEN HUNDRED AND SEVENTY-NINE.

One cannery at Sitka—reported cases	7,000
One cannery at Prince of Wales Island—cases	7,000
One cannery at Skeena River—cases	Unknown.
Seven canneries at Fraser River—cases	15,000
One cannery at Puget Sound—cases	1,300
One cannery at Gray's Harbor—cases	Unknown.
Thirty canneries at Columbia River—reported cases	438,000
Two canneries at Sinslaw River—cases	Unknown.
Two canneries at Umpqua River—cases	Unknown.
One cannery at Rogue River—cases	Unknown.
Forty-seven canneries—total cases	468,300

Average value, $4 30 per case, or $2,013,690.

The catch at Gray's Harbor, Sinslaw, Umpqua, and Rogue Rivers is had in September, October, and November.

STATEMENT OF SALMON TAKEN FROM THE SACRAMENTO AND SAN JOAQUIN RIVERS, FROM SEPTEMBER FIFTEENTH, EIGHTEEN HUNDRED AND SEVENTY-SEVEN, TO AUGUST FIRST, EIGHTEEN HUNDRED AND SEVENTY-EIGHT.

65,046 loose salmon, weighing	1,626,150 pounds.
808 baskets and sacks of salmon, weighing	81,050 pounds.
2,361 boxes of salmon, weighing	170,715 pounds.
44 barrels of salmon, weighing	8,700 pounds.
48,794 cases canned salmon, weighing	3,330,000 pounds.
Total, say 304,411 salmon, weighing	5,216,615 pounds.
4,460 sturgeon, weighing	334,500 pounds.

STATEMENT OF SALMON TAKEN FROM THE SACRAMENTO AND SAN JOAQUIN RIVERS, FROM SEPTEMBER FIFTEENTH, EIGHTEEN HUNDRED AND SEVENTY-EIGHT, TO AUGUST FIRST, EIGHTEEN HUNDRED AND SEVENTY-NINE.

97,503 loose salmon, weighing	2,437,575 pounds.
312 sacks and baskets of salmon, weighing	37,740 pounds.
452 boxes of salmon, weighing	41,086 pounds.
18 barrels of salmon, weighing	4,950 pounds.
40 cases of smoked salmon, weighing	12,400 pounds.
13,855 cases of canned salmon, weighing	1,012,850 pounds.
Total, say 171,438 salmon, weighing	3,546,601 pounds.
7,104 sturgeon, weighing	607,800 pounds.

The above statements do not include the catch above Sacramento on the Sacramento River, or above Stockton on the San Joaquin River. In former reports we have added 25 per cent. to the figures reported as being a fair equivalent for the unreported catch above Sacramento and Stockton, and for the fish caught during the close season and salted and smoked in by-places in the tules. Adding this would make the catch of salmon of the season of 1877–8 as 6,520,768 pounds, and the season of 1878–9 as 4,433,250 pounds, as heretofore stated.

The catch of the season of 1877–8 was the largest of any since we commenced obtaining statistics, and is in fact the practical result of artificial hatching. Fish hatched in a given year do not begin to show in the returns until three or four years after the young fish are placed in the water. After nine years of study and observation, combined with considerable practical experience, we are prepared to answer the question as to the practicability of keeping up the supply of salmon in the Sacramento, notwithstanding the increase of population, extended facilities for transportation, and the multiplication of canning establishments, nets, and fishermen.

First—There must be an honest close season, faithfully observed by the fishermen, to allow a portion of the ripe fish to reach the spawning grounds. This would keep up a normal supply in the river, which normal supply would depend upon the area of clean gravel beds at the sources of the streams over which pure water was passing of a proper temperature. It would also give a supply of fish at the only places where their eggs could be taken for artificial hatching.

Second—The thousands of sea lions and seals at the Golden Gate and in the bay—carefully protected by legislative enactment—without doubt catch more fish annually than all the nets of the fishermen. These rapacious animals observe neither close season nor Sunday, live wholly on fish, and are unceasing in their work of destruction. They should be reduced in numbers or driven to some other part of the coast.

Third—A portion of the fish being allowed to reach their spawning grounds, and their destruction by sea lions and seals at the Golden Gate prevented, the number of salmon in this river would depend simply on the amount of money which the Legislature should deem proper to appropriate for the purpose.

After the female salmon escapes all her enemies in the ocean, the sea lions at the Golden Gate, the seals in the bay, and miles of nets in the river, and swims blindly against a stream of more than one hundred miles of muddy water thick with mining sediment and at last reaches the clean gravel beds of the ice-cold sources of the river to perform the duties of maternity, she is still beset by numerous enemies. In the most favorable streams, the areas are not large—having proper beds of gravel, appropriate depth, and the right temperature of water—on which the eggs can be deposited. When the eggs are deposited, observation and experiment have shown that only an average of eight per cent. of them come in contact with the fertilizing sperm of the male—ninety-two per cent., of course, die. This eight per cent. is liable to be destroyed by trout and other fish, or to be smothered by a deposit of sediment caused by heavy rains on the summits of the mountains.

A mature female salmon of the Sacramento will yield 800 eggs to each pound in weight of the fish; thus, a fish of 20 pounds will yield 16,000 eggs. It has been estimated that, in a state of nature, not more than two eggs in a thousand ever become fish. This would give the product of the 16,000 eggs, 32 fish. By the discoveries in artificial hatching, these 16,000 eggs can be made to produce 15,000 fish. Every egg can be fertilized and kept under control and inspection in the most favorable conditions as to the current, purity, and temperature of the water, shaded from the direct rays of the sun, and closed securely against the almost innumerable finned, winged, and furred enemies that are seeking to devour it. The young fish, when they come from the egg, can be kept and fed until the most favorable period for placing them in the river. One million eggs can be taken, fecundated, hatched into young salmon, and turned into the river at an expense not to exceed $1,200, and larger numbers at a less ratio. As they find in the ocean the food upon which they grow and become fat, they exhaust nothing from the river; therefore, if some fish are allowed to reach their spawning grounds, the number of salmon in the river can be in proportion to the amount of money the Legislature may see proper to appropriate for their artificial hatching.

WHITE FISH (COREGONUS ALBA).

Through the kindness of Professor Baird, United States Fish Commissioner, we have, since our last report, received from Lake Michigan, as a donation, nearly one million eggs of this most valuable food fish. The first lot of 300,000, which arrived January 20th, 1878, had been so kindly cared for by the agents of the express company that they were placed near the stove in the car, and were killed by the heat on the journey. The second lot arrived in good condition, and were successfully hatched out at the State hatching-house, San Leandro, and were distributed as follows:

January 11th, 1879—To Lake Tahoe, Donner Lake, and lakes at summit of Sierra	200,000
January 18th, 1879—To Eagle Lake, Lassen County	225,000
January 21st, 1879—To Tulare Lake	100,000
February 1st, 1879—Mark West Creek	10,000
February 17th, 1879—San José Water Company's reservoir	10,000
February 17th, 1879—Lake Chabot	20,000
Total	565,000

Some of the previous importations of these fish, planted in Tahoe, Tulare, and Clear Lakes, have thrived, and a few mature fish are reported as having been caught in each of these lakes. All of these bodies of water will, without doubt, within a few years, be stocked with this valuable fish. As the white fish is only taken by nets, these lakes will be fully stocked before it will be found profitable for fishermen to make a business of catching them. A discovery of some importance in the care of the young of the white fish was made by Mr. J. G. Woodbury, in charge of the State hatching-house. This fish lives on the crustacea found on the rocks at the bottoms of deep lakes, and as it was not known on what the young fish could be fed, it has heretofore been necessary, within a few days after the young fish have emerged from the egg, to place them in the lakes to find their own food. Mr. Woodbury found that by pounding to a jelly the flesh of the common salt-water crab, the young white fish would eat and thrive upon it. He kept 50,000 on this food for more than two months. This discovery is of much interest, as it enables the young fish to be kept for some time, and thus distributed to stock mountain lakes that are inaccessible during the winter months.

SHAD (ALOSA SAPIDISSIMA).

In June, 1878, we received from Professor Baird, United States Fish Commissioner, from Havre de Grasse, 115,000 young shad; these were placed in the Sacramento River at Tehama, where all previous importations have been planted. The State has now received from the United States Government, and by our own importations, in all, 400,000 of these fish. There can be no doubt they find congenial homes in Pacific Coast waters, and are thriving and producing their kind. Several thousand mature fish have been taken and sold in the San Francisco markets during the spring of 1879. A few are found in market during almost every month in the year. After leaving the Sacramento River, the great body of these fish follow the coast south to the Bay of Monterey, where they must remain, finding an abundance of food; for a few are caught in the nets of the fishermen in this bay during every week throughout the year. If the appropriation were larger, we would do more towards stocking our rivers with this fish. No discovery has yet been made of any substance with which the young can be fed, and as seven days is the longest period they can be kept alive without food, we are compelled to take the number of young fish hatched from the eggs of one night's catch in an Atlantic river, and hurry them by express trains across the continent to Sacramento. The expense of such a journey with the necessary attendance, is almost $1,800, and as the number of fish to be obtained is uncertain, a larger importation of young shad would involve an expense which would lessen the number of young salmon which it seems imperative we should supply to the river each season.

SCHUYLKILL CATFISH (AMIURUS ALBIDUS).

In 1874 we imported from the Raritan River, and placed in lakes near Sacramento, 74 of these valuable fish. These have increased to millions and furnish an immense supply of food. They have become so numerous that they are as regularly on sale in the city markets as the most abundant native fish, and are sold at about the same prices. They thrive in our rivers and lakes, and in the still-water sloughs of our plains, as well as in the brackish sloughs in our tule lands. They appear to be equally at home in lakes on the mountains and in artificial reservoirs in the valleys. Many farmers who have natural ponds on their farms, or who have surplus water from wind-mills and have made artificial ponds, have stocked them with this excellent fish. The produce of the few fish of this species, imported in 1874, now annually furnishes a large and valuable supply of fish food to people in the interior of the State. The value of all the fish of this species, now caught annually and consumed as food, would more than equal the annual appropriation made by the State and placed at the disposal of the Fish Commissioners. This variety of catfish has valuable characteristics which admirably fit it for wide distribution and for self-preservation in the struggle for existence. The female makes a round nest in the bottom of a pond in which she deposits usually from 3,000 to 5,000 eggs. These are fecundated by the male who then leaves them to the care of the female. The mother remains over them fanning them with her fins, probably to keep them oxyginated with fresh currents of water, as well as to prevent them being smothered by sediment. She remains in constant attendance, driving away every fish that approaches her nest. In from six to ten days the young make their appearance. Her care does not cease with the birth of the young fish. She now swims about them in a circle, keeping them together until all are hatched. When all the young fish are fitted to swim she leads them off to find food, still keeping them in a body by circling about them and driving back wanderers, as a trained shepherd dog drives in a wandering sheep; she will at the same time fight any other fish that comes near her charge. In another week or ten days they are prepared to search for their own food, when they gradually disperse. Since our last report we have distributed 39,000 of these fish to public waters to stock rivers, ponds, and reservoirs in the Counties of Butte, San Joaquin, Yuba, Sonoma, Ventura, San Diego, Sacramento, Placer, El Dorado, Alameda, Colusa, Yolo, Sutter, Nevada, Stanislaus, Tuolumne, Modoc, Los Angeles, Mono, Solano, Mendocino, and Lassen.

LAND-LOCKED SALMON (SALMO SEBAGO?).

In January, 1878, through the kindness of Professor Spencer F. Baird, United States Fish Commissioner, we received from the United States hatching-house of Grand Lake Stream, Maine, 50,000 eggs of the land-locked salmon. This fish is found in a few lakes in the northern part of the State of Maine. In structure they are the same as the Atlantic salmon (*salmo salar*). They have probably been derived from the Atlantic salmon, which, by some natural cause at a remote period, were prevented from returning to the ocean. Their descendants, finding sufficient food in these lakes, have lost the instinct which compelled their ancestors to return to the ocean, and they are now fitted to live continuously and breed in fresh water streams and lakes. As was stated in our last report, the California salmon (*quinnat*) has the same characteristics, and readily adapts itself to a life in fresh water. The reservoir of the Spring Valley Water Company, supplying San Francisco with water, and known as San Andreas and Pilarcitos, are well stocked with salmon, the product of those prevented from returning to the ocean by the constructions of the dams. Lake Chabot, the reservoir from which the City of Oakland is supplied with water, is also well stocked by the same means, and from young salmon placed therein. In the winter of 1875–6 a large number of young salmon were placed in the Truckee

River. This river has its rise in Lake Tahoe and flows into Pyramid Lake, in Nevada, and has no outlet to the ocean. Some of these salmon are reported to have been taken with the hook in the Truckee River this season, weighing from three and a half to five pounds. The size to which the Sacramento salmon will grow when confined to fresh water depends upon the quantity of food to be found in the lake or stream. A few years after the dam was erected at the San Andreas reservoir salmon were taken in it weighing from six to twelve pounds. In ten years they have multiplied until hardly any other fish are taken, but now do not average to exceed three-fourths of a pound. They now mature their eggs and milt when less than a pound in weight. The land-locked salmon of Maine do not average over six pounds in weight, but they are numerous in the lakes, furnish a large amount of food, and yield much sport to the angler, as they readily take both fly and bait. As they are natives of the cold lakes of Maine we have thought the most appropriate places for the distribution of the young fish would be in our mountain lakes; but, for purposes of testing their fitness to thrive in warmer waters, a portion were also distributed to lakes in the valley and on the coast, as follows:

March 16th, 1878—Donner Lake and other lakes near the summit	10,000
March 20th, 1878—San Francisquito Creek, Espenosa Lake, etc.	10,000
April 6th, 1878—Tulare Lake	15,000
April 7th, 1878—San Leandro Creek and Lake	2,500
April 8th, 1878—Arroyo Laguna, near Sunol	700
April 19th, 1878—Reservoir at Alms House, San Francisco	1,000
April 30th, 1878—Echo Lake, El Dorado County	250

EASTERN BROOK TROUT (SALMO FONTINALIS), PACIFIC COAST BROOK TROUT (SALMO IRIDEA), DOLLY VARDEN TROUT (SALMO CAMPBELLII), AND TAHOE TROUT (SALMO TSUPPITCH).

In January, 1878, and in January, 1879, we received from Wisconsin and New Hampshire 70,000 eggs of the Eastern trout. The young fish were hatched at the State hatching-house, San Leandro, and were distributed as follows:

March 1st, 1878—Streams in Santa Barbara County	5,000
March 16th, 1878—North Fork of the American, Prosser Creek, and Truckee River	10,000
March 19th, 1878—Kaweha River, Tulare County	5,000
March 20th, 1878—Carmel and streams in Monterey County	7,000
March 25th, 1878—Streams in Alameda County	2,000
March 26th, 1878—San Leandro Creek, Alameda County	5,000
March 30th, 1878—Russian River and Sulphur Creek, Sonoma County	6,000
April 5th, 1878—Santa Rosa and Mark West Creeks, Sonoma County	3,000
April 5th, 1878—Streams in Santa Cruz County	2,000
April 5th, 1878—Steams in San Mateo and Santa Cruz Counties	4,000
April 8th, 1878—Alameda Creek and tributaries, Alameda County	2,000
April 15th, 1878—Calaveras Creek and small streams, Alameda County	2,000
March 1st, 1878—North Fork of American, South Yuba, and tributaries of Truckee River	20,000
March 29th, 1878—Yosemite Valley	1,000

Of the trout eggs of California trout procured from McCloud River, the young fish were distributed as follows:

March 30th, 1878—Russian River and tributaries	6,000
March 30th, 1878—Santa Rosa and Mark West Creeks	3,000
April 5th, 1878—Santa Cruz, Aptos Creeks, etc.	4,000
April 8th, 1878—Alameda Creek and tributaries	2,500
April 7th, 1878—Streams in Santa Clara County	2,000
April 18th, 1878—Streams in Santa Cruz County	10,000
May 9th, 1878—San Lorenzo Creek, Alameda County	1,000
May 9th, 1878—Streams in Alameda County	5,000
March 21st, 1879—Streams in Santa Cruz and San Mateo Counties	7,500
March 27th, 1879—Streams in Santa Clara and Monterey Counties	9,000
March 29th, 1879—Yosemite Valley	20,000
April 1st, 1879—San Gregorio and Pescadero Creeks, San Mateo and Santa Cruz Counties	8,000
April 1st, 1879—Streams in Alameda County	1,000
April 3d, 1879—Tuolumne River	2,000
April 7th, 1879—Streams in San Mateo County	7,000
April 15th, 1879—Streams in Alameda County	6,700

The few Dolly Varden trout that we succeeded in hatching were distributed in streams at the summit, and in the Truckee River.

In September we purchased 50,000 young Tahoe trout that had been hatched by Mr. Frazer, and distributed them in the Truckee River, in the North Fork of the American, and in the South Yuba. These fish were placed in the Truckee on the petition of the people residing on that river, who complained that for some years the trout in that stream had been gradually decreasing in numbers. There are now fish ladders over the dams on the Truckee, and, if maintained, it is probable a supply of trout can be kept up in this river.

The eastern trout does not appear to thrive in the streams of the Coast Range of mountains. These mountains are composed of sand stone, which is readily worn by the winter rains and, at certain seasons, all the streams from them carry a large amount of sediment and become more or less discolored. There is also a great difference in the temperature of the water in winter and summer. The native home of the eastern trout, as its name implies, is in the clear cold sources of mountain streams. Wherever planted in the cold clear streams of the Sierra Nevada, in water flowing over granite and slate, they find congenial homes, and thrive and propagate equally with the native trout.

Probably there is no trout more valuable for wide distribution than the Pacific Coast brook trout (*Iridea*). It grows rapidly, occasionally weighing seven pounds when it can feed in salt water at the mouths of coast streams, and often weighing five pounds when confined entirely to fresh water containing an abundance of food, as in the McCloud River. Some specimens of McCloud trout, kept in the hatching-trough in the fishery at San Leandro, grew to average seven inches in length in one year from the time the eggs were placed in the hatching trays. It does not seem to be injuriously affected by a long continuance in water containing a large amount of muddy sediment. We are not aware of experiments having been made to test, with exactness, the highest temperature of water in which it will exist and thrive, but without doubt it will live in water so warm as to be fatal to eastern trout. We believe it could be successfully introduced into streams on the Atlantic Coast where eastern trout would not thrive.

LOBSTERS (HOMARUS AMERICANUS); EELS (ANGUILLA); STRIPED BASS (ROCCUS LINEATUS), AND BLACK BASS (MICROPTERUS NIGRICANS).

In 1874, with the aid and experience of Mr. Livingston Stone, we made the attempt to stock the waters of the Bay of San Francisco with lobsters. Mr. Stone left Boston in a car prepared with all the appliances then known for transporting fresh and salt water fish. One portion of his charge consisted of 150 lobsters. With the exception of four all of these died on the journey. These four were placed in the Bay of San Francisco at the end of the Oakland pier. They were alive, but seemed feeble, and we had small hope that they would survive and propagate. Since that time reports have been made that young lobsters have been caught in the bay. An examination of all that have been brought to us, as young lobsters, has shown that they belonged to some other family of crustacea. (In July of the present year (1879), Mr. Livingston Stone again made the attempt to bring lobsters, eels, striped bass, and black bass from the Atlantic States.) Availing himself of his experience obtained in former journeys, and having learned by repeated experiments a method of retaining ocean water in a state of purity in small tanks, he succeeded, by constant work and assiduous attention, in bringing from the Atlantic Ocean and depositing in the Pacific Ocean at the Golden Gate, 24 female lobsters. It is estimated that these lobsters had attached to them more than two million eggs, all of which would hatch within a week from the time they were deposited. We believe we can now look forward with confidence to the time when lobsters will be found in abundance in our waters.

In 1874 a few young eels were brought from the Atlantic and planted in lakes near Sacramento, and others in the Bay of San Francisco, near Brooklyn. We have no reports of those placed in the salt-water. Several have been taken in the fresh-water, near Sacramento, full grown, and three feet in length. Finding they would thrive, we obtained, through Mr. Stone, 4,000, which, in July, were planted, one-half in the Sacramento River, and the other half in Alameda Creek. Without doubt they will, in a few years, fill our streams.

At the same time Mr. Stone brought from the Neversink River, New Jersey, 150 young striped bass, which were successfully turned into the brackish water of the Sacramento River, at Martinez. It is to be hoped they will escape the nets of fishermen, the sea lions, and seals. Should a few pair survive their enemies and propagate they will add a most valuable food fish to our salt, brackish, and fresh-waters.

The 73 black bass brought in the aquarium car of 1874 were planted in Napa River. A number of these were caught in 1875, and probably all were exterminated by anglers, who could not wait until time had been given the fish to breed. We can hear of none having been caught during the past two years. We have again made the attempt to introduce this valuable fish. In July last Mr. Stone again brought 24 black bass, and 22 fully mature fish were placed in the Crystal Spring reservoir of the Spring Valley Water Company, in San Mateo County. We have the assurance of the officers of the company that this reservoir shall be preserved, and no fishing allowed in it for three years, or until such time as we desire to take young bass for stocking other waters.

CARP (CARASSIUS VULGARIS).

We have been unable as yet to introduce the king carp, with which to stock our inland sloughs and warm water lakes. This, the most valuable variety of the carp family, was imported from Germany by Professor Baird, United States Fish Commissioner, a few years since, and has increased to large numbers in ponds at Washington and Baltimore. They could not be obtained in July, at the time Mr. Stone left with fish for California. We now hope to receive the State's quota in June, 1880, with another consignment of young shad. It is certain they will thrive in California, as another variety of carp, imported as a private speculation some years since, has been extensively distributed over California, and now furnish a large amount of food to people in the interior valleys. We do not know any fish so desirable for wide distribution throughout the State as this carp. They are of good flavor, grow rapidly, are tenacious of life, can live on aquatic vegetation, and in water too warm for almost all other valuable varieties of food fish. We can hardly do a more useful work than in the breeding of these fish, and stocking all our interior streams, lakes, and sloughs with carp.

FISH-WAYS.

We have caused a few suits to be commenced to compel the owners of dams to construct fish ladders. In almost all cases, when notified, the owners of dams have complied with the law. It is generally understood by the people of the State, that to preserve fish in our rivers, it is absolutely necessary that fish should be allowed to reach their spawning grounds The efforts of your Commissioners to keep up the supplies of fish in our rivers, and to add new and valuable varieties, appear to be appreciated, and we find there is in almost every neighborhood some man who has sufficient interest in the subject to call our attention to obstructions when such exist.

OCEAN AND BAY FISH.

More than ninety varieties of fish are caught in the Bay of San Francisco, and in the Bays of Monterey and Tomales, which are sold for food in the San Francisco market and shipped to various points in the interior. This gives employment to many hundred men, and their work furnishes a vast amount of food to our people. So far as we have been able to ascertain, but one variety is identical with an Atlantic Coast fish (the halibut). The consumption of fish is so large on this coast that it seemed desirable to obtain the statistics in relation to it. We have found this very difficult. Many of the fishermen are Greeks, Italians, Portuguese, and Chinese, who do not speak English, and few keep a written record of their catch. The dealers do not care to exhibit their books. Many of our fish are without English names, and one English name is made to apply to different varieties of fish. Two of the varieties of fish sold as smelts in our markets do not belong to this family. Three different fish are sold as candle fish, etc. Where fish, as in the case of salmon, are mostly brought to market by transportation companies, the annual catch can be ascertained with approximate correctness. At present it seems impossible to obtain statistics of the catch and consumption of salt-water fish. Not being able to obtain these facts, it then seemed desirable to know what salt-water fish furnish the largest amount of food to our people? What are their names, and in what months are they most numerous? To ascertain these facts and make a record of them, we obtained the valuable services of Mr. W. N. Lockington, who for some years has been making a study of the fish of this coast, and who has added to the science of ichthyology several new varieties. Mr. Lockington has watched the market for a year, keeping a record of all the varieties of fish sold as food, their first appearance, abundance, and disappearance. His report, which follows, will be found of great value, as it is the first attempt to collate, classify, and name the various fish which make their appearance in the San Francisco markets during a year.

APPROPRIATION AND EXPENSES.

A detailed statement of the appropriation received and expenses incurred will be found at the close of this report. We are gratified that the work of the Commissioners appears to be approved by the public. We may be pardoned in the expression of the belief that not many other of the State's appropriations produce more beneficial and practical results. When fish valuable for human food are introduced into barren waters, or when valuable fish are made to supplant worthless kinds, the beneficial results are not confined to the present time and to the present generation of men. With that better observance of wise laws for the preservation of fish that is sure to come with increased intelligence these beneficial results will spread and increase, and the produces from the fish now introduced and planted will furnish food to those who come after us so long as our streams continue to flow, and while our lakes and reservoirs continue to hold water.

REPORT UPON THE FOOD FISHES OF SAN FRANCISCO

BY W. N. LOCKINGTON.

About ninety species of fishes are brought in greater or less numbers to the markets of San Francisco, either at certain seasons or during the greater portion of the year. Most of these are in esteem as food fishes, while the remainder, either from their scarcity, their small size, their repulsive appearance, or their actual deficiency of flavor, are not usually eaten by people of European descent, though some of the more abundant kinds are in favor with the Mongolians.

In the following pages it is proposed to bring together a few facts relating to the comparative abundance, seasonal and geographical distribution, size, etc., of the various species used to any extent as articles of food, together with such notes upon their food and habits as the limited opportunities of the writer have enabled him to collect. Particular care will be taken to point out some of the more obvious characters of each species, so that any one interested in the important subject of our fish supply may be able to distinguish them. Little attempt at technical description will be made, and the synonymy will be limited to the recognized name of each species, together with, in some cases where a change has recently been made, the title given by its original describer. The writer regrets the paucity of his original information, but a beginning must be made, and he trusts that all who are in possession of facts relating to our fishes will report the same to him or to the Fish Commissioners.

The groups of fishes which are of most importance, from an economical point of view, are the *Salmonidæ* (using the word in its old meaning), the *Embiotocidæ* or viviparous perch, a family almost confined to this coast; the *Pleuronectidæ* or flat-fishes, and the rather heterogeneous group commonly known by the English name of rock-fish or rock-cod, and comprising numerous species of the family *Scorpœnidæ*, with others belonging to the *Chiridæ*.

Probably the *Salmonidæ*, including as it does the *quinnat* and other anadromous salmon, together with the lake and brook trouts and the smelts, is the most important of these groups, since the *quinnat* and other species of the genus *Oncorhynchus* not only furnish a large proportion of the fish supply of this coast, but are canned in large quantities for exportation.

As the particulars of the salmon supply, with the details of the work done in hatching and preserving the young of these valuable fishes, have been given in the regular report of the Fish Commissioners, the present report will deal only with the small marine species of the group. It would not be easy to say which of the other three groups mentioned above is of most importance as food, since each of them contains from thirteen to eighteen species, some or other of which are plentiful during every season of the year; but the three contain the greater proportion of the individuals and species usually sold in the markets. Next to them come the sturgeon, the *Sciænidæ*, which family furnishes two valued species, the *Atherinidæ*, or so-called smelts, and lastly the *Gadidæ*, or codfish, and the *Clupeidæ*, or herrings, two families which do not occupy the prominent position accorded to them elsewhere, since only one or two species of each are sufficiently abundant to form an important item in the total fish supply. Several species of *Scombridæ* (mackerel, as the family was defined by the older naturalists) occur along the coast of California, but none of these are taken, except occasionally, in the immediate vicinity of San Francisco, and none of them are brought to our markets either regularly or plentifully.

With the exception of a single species of skate, all the marine fishes habitually eaten by the white residents of the city belong to one or other of the families enumerated above.

The quantity of fresh-water fishes (excluding the salmon) brought to our markets is not very large, and consists chiefly of four species of *cyprinidæ* (*Eventognathi*, Gill) and the Sacramento perch.

Certain introduced fishes are now becoming sufficiently abundant to be worthy of enumeration among our food fishes, although they are only occasionally brought to market, and are sold at a high price. These are the shad, *Alosa sapidissima*, the Prussian carp, *Carassius vulgaris*, and a species of catfish, *Amiurus albidus*. The first of these is still very scarce, and fetches a very high price, but some examples attain quite respectable dimensions, and the supply is tolerably constant. The largest I have seen measured twenty-six inches in length by seven in width; another was twenty inches long by five and a half wide; and a third intermediate between these. The Prussian carp was first introduced by Mr. Poppe, of Sonoma County, but has since been raised at other places. Those sent to the market were from Port Harford.

During the time that the writer has systematically watched the market he has been so fortunate as to discover several new species of fishes, of which three belonging to the *Pleuronectidæ*, a *Lycodoid*, and a *Scomberoid*, are of more or less value as food fishes. This occurrence of previously undescribed species, as well as the abundance of numerous other species formerly little known, may be partially attributed to the fact that the fishermen now trawl in deeper water than formerly, going to thirty-six fathoms or more, and partially to the facility with which, now that railway communication is established, the fishermen of Monterey and other places can send their catch to San Francisco. In the days when Dr. Ayres watched the markets and described so many of our fishes, the Monterey fishermen did not have the advantage of supplying the San Francisco market; on the contrary, the fishers of our bay sent a portion of their catch to points between San Francisco and Monterey that are now supplied by the Monterey fishermen. This competition, together with the vast quantities taken out of the bay by the Chinese, the havoc worked by the protected legion of sea lions at the entrance of the Golden Gate, and the want of any close time for the more useful kinds of fishes, threaten, in the course of time, to make the local fishery unremunerative to the hard-working men engaged in it. It is much to be regretted that the white fishermen themselves, by their indiscriminate destruction of young fishes, and uncompromising slaughter of adults during the spawning season, appear anxious to hasten that destruction.

Already the fishery carried on in the Bay of San Francisco is much less productive than it was in the early days of the American occupation; species that were once common have become scarce, and others still tolerably abundant fail to attain their full dimensions. Nor is over-fishing the sole cause of this. The constant hurrying to and fro of the numerous ferry-boats and other steamers, indispensable to our comfort, tends to drive away the timid finny tribes, whilst the ashes and cinders let fall injure the character of the bottom.

But the injury from this source is small compared with that inflicted by the constant fouling of the waters and consequent destruction of life by the fœtid inpourings of our sewers; by that foolish waste of organic substances, which has now become an integral part of what we consider civilization, materials which, if spread upon the land, would cause our sandy wildernesses and bald hill-sides to bear a luxuriant crop of cereals, and would thus bring life, or, which is almost the same, the means of life, to thousands of human beings, are now poured into the waters to pollute them for the destruction of creatures on which human beings are largely dependant for the means of life. As the supply in San Francisco Bay has become limited the scene of wholesale destruction is now shifted to Tomales Bay, whence a very large proportion of our fish supply is now brought. Although the fishes of the cod family are not prominent among the supply of fresh fish sold in the markets, codfish are extremely abundant on the shores of British Columbia, Alaska, and Kamtschatka, and about thirteen vessels belonging to San Francisco are engaged in the cod fishery, which is carried on in much the same manner as that of the Newfoundland Banks. Rather the larger portion of the catch, which in 1878 amounted to about 1,500 tons, is taken in the Okhotsk Sea, the remainder principally at the Shoumagin Islands. The greater part of the supply is consumed in California; but some is sent to South American ports upon the Pacific, and even to Australia. The drying of these fish is not done upon the spot, but at drying establishments on the shores of San Francisco Bay. The fishery is at present carried on in comparatively shallow water, although, as in the Atlantic, it is observed that the fish from deeper water are the best. The cod of the Pacific cod-fishery is a true *Gadus;* but, as no entire specimens have yet been carefully examined, it is uncertain whether it is to be referred to *Gadus auratus*, Cope, or to one of the species described by older writers.

Small quantities of halibut (*Hippoglossus vulgaris ?*), herring (*Clupea mirabilis*), and eulachon (*Thaleichthys pacificus*), are preserved in various ways for the San Francisco market, but these branches of our fisheries are in their infancy.

The halibut is abundant, attains large dimensions, and is probably equal in every respect to that of the Atlantic, yet it cannot compete in San Francisco with the Eastern article. It is occasionally canned like the salmon.

The eulachon is one of the fishes which, from their oiliness and the use made of them by the Indians, are called "candle-fish." Some are brought down in salt, while others are put up with oil in boxes and sold as sardines.

SUBCLASS TELEOSTEI, BONY FISHES.

In the fishes of this subclass, the skeleton is more or less ossified, instead of cartilaginous, as in most of the *Ganoidei* (sturgeon, etc.), and in the *Elasmobranchii* (sharks, rays, etc.). The caudal fin is regular or homocercal, rarely absent; the optic nerves from opposite sides simply cross without forming a network or chiasma; the arterial bulb of the heart is simple, and provided with two valves at its origin; the air bladder is simply what its name denotes, never becoming cellular or lung-like; opercles or gill-covers are always present, and the body is usually covered with scales, though in some cases scaleless, or with prickles or bony plates in lieu of scales. This subclass comprises all those vertebrates usually called fishes, except the somewhat miscellaneous group *Ganoidei*, of which the sturgeons are the only representatives upon the coast of California; the *Elasmobranchii*, comprising the sharks and rays, which are not generally used for food; the *Marsipobranchii* or lampreys and hags, the former often eaten; and the *Leptocardii* or lancelets, the lowest of vertebrates, if indeed they are entitled to that name at all.

The *Teleostei*, according to Professor Gill's classification, are divided into the orders *Teleocephali* or ordinary fishes; *Nematognathi* or silurians, comprising the catfishes and numerous other forms, chiefly fresh-water, all characterized by the presence of from four to eight long barbels around the mouth, the longest a continuation of the incomplete maxillary, and with numerous other characters which render them a compact group; *Apodes* or eel-like fishes, having no ventrals, the scapular arch or shoulder-girdle free from the skull, instead of attached to it as in the other orders, and an elongated, snake-like body; *Pediculati*, including a few strange forms in which the pectoral fins are carried by elongated bones, which foreshadow those of the forelimbs of higher vertebrates, and which have small gill openings behind the pectorals; *Plectognathi*, balloon fishes, etc., which have the intermaxillary and maxillary bones firmly united; and *Lophobranchii*, pipe fishes, which have their gills in small tufts instead of in long comb-like series, as is the case in all the preceding orders, and the mouth small and toothless, placed at the end of a long snout. Besides these are the two small orders *Scyphophori* and *Opisthomi*, neither represented on this coast. As all the indigenous *Teleostei* of California, ordinarily used as articles of food, belong to the first of these orders, *Teleocephali*, it may be as well to dismiss the others with a few words so as to avoid future reference to them.

Although the order *Nematognathi* has numerous representatives in North America (Jordan, catalogue of fresh-water fishes, pages 414–415, enumerates 28), and may be said to have its headquarters in South America, not a single species is indigenous in the streams of the Pacific Coast; and the order *Apodes* is not represented in the neighborhood of San Francisco. Here, then, we have two remarkable features of our fish fauna, no catfishes and no eels in our rivers, for though several kinds of fishes, both fresh-water and marine, are often called eels, they are only elongated *Teleocephali* or else lampreys. The *Pediculati* are represented in Lower California, but not in Upper California. Only a single *Plectognath* fish is ever brought to our markets, although another species occurs in the southern part of California, and the order has several representatives farther south. This solitary *Plectognath* is the wide-spread *Orthagoriscus mola* or sun-fish, if, as seems probable, it is really identical with that Atlantic species. I have not yet had the good fortune to meet with a fresh example, but a small specimen is in the Museum of the California Academy of Sciences, and a larger, about three feet long, in the collections at Woodward's Gardens. In the Proceedings of the California Academy of Sciences of 1867, page 141, Mr. R. E. C. Stearns mentions the occurrence in the market of a specimen, 5 feet 8½ inches in extreme length, and 7 feet 6 inches in width from tip of dorsal to tip of axal. The small specimen, on which Dr. Ayers founded his *Orthagoriscus analis*, was taken in Santa Barbara Channel.

The *Lophobranchii* are represented in our bay by two species of pipe-fishes, *Syngnathus dimidiatus* and *Syngnathus griseolineatus*, both occasionally brought to market, but both too small to be used as food, and in the more southern part of our coast by *Hippocampus ingens*, the great Californian sea-horse, of which our museum possesses a single specimen.

The *Teleocephali* include the greater part of the orders *Malacopteri*, *Anacanthini*, and *Acanthopteri* of older naturalists, but as Professor Jordan well remarks, "however different the extremes of each (as *Percoids* and *Cyprinoids*) may be, the intervening forms are too closely related to render it possible to characterize them as distinct orders."

The suborders now recognized in this large order are the *Heterosomata* or flat-fishes, the *Anacanthini*, the *Acanthopteri*, the *Percesoces*, the *Hemibranchii*, the *Synentognathi*, the *Haplomi*, the *Isospondyli*, the *Eventognathi* or carp tribe, and the *Gymnonoti*. Of the last tribe, the electric eels, we have no examples; the *Hemibranchii* or half-gilled fishes, chiefly consisting of the small tribe of sticklebacks, too small for use as food, and of the *Fistularians*, need not here be considered; and the *Synentognathi* or gar-pikes, and the *Haplomi* do not occur in our markets. Representatives of the other suborders, which, after all the other classes, orders, and suborders are taken away, still include far the greater proportion of the families, genera, and species of gill-breathing vertebrates, are numerous here as in most other parts of the world. A noticeable feature of the California fish fauna is the almost total absence of *Acanthopterous* or spiny-finned fishes from the fresh-waters, which are stocked almost wholly by the *Salmonidæ* (a family of *Isospondyli*), and by the *Eventognathi* or throat-jawed fishes.

ORDER TELEOCEPHALI.

Bony fishes with terminal mouths, the maxillaries and intermaxillaries distinct, and well developed pectinated (or comb-like) gills; gill openings in front of pectorals and comparatively wide; and a sub-operculum (this bone is absent in the order *Nematognathi*). Scales usually present, and generally cycloid or ctenoid.

SUBORDER ACANTHOPTERI.

Teleocephali normally with ctenoid scales, a spinous dorsal fin, either separate, or forming the anterior portion of a single dorsal; one or more spines in front of the anal, and an articulate first ventral ray. One or other of these characters often fails, but a constant character is the absence of the ductus pneumaticus, or tube connecting the swim-bladder with the gullet.

PERCIDÆ.

This large group of typical *Acanthoperous* fishes, with spinous fins and highly ctenoid scales, is, by some naturalists, divided into several families or sub-families, two of which, the *Serranidæ* and the *Centrarchidæ*, each send to our markets a single representative, the first occasionally, the second with tolerable regularity.

Archoplites interruptus, Girard, Sacramento River Perch—This species is abundant along the lower course of the Sacramento and San Joaquin Rivers, and in all branches of those rivers that permeate the low lands, and forms an important article of food not only to the white inhabitants of the district but also to the Chinese, who are particularly fond of it, catch it in immense numbers and forward it to their countrymen along the railroad, as far as the boundary of the State, or even beyond it. It is usually taken in fyke-nets, which are most effective engines of destruction. It is a very good fish for the table, unless taken in sloughs that, by the falling of the water, have become disconnected with the river. During the winter months this species was rarely brought to the markets of San Francisco, but from February to September it has been of constant occurrence. Although usually known as the Sacramento River Perch, it is by no means confined to that river and its tributaries. Professor Jordan (Bulletin, United States National Museum, 10, p. 34) gives "streams of the Pacific slope" as its habitat; the Museum of California Academy of Science has a specimen from the Pajaro River, and Mr. Livingston Stone states that it occurs in Clear Lake. This species belongs to the *Centrarchidæ*, a group which includes the numerous species of "sunfishes," or "pond fishes," numbering altogether (according to Professor Jordan) sixteen genera and sixty species. The headquarters of this family is in the Mississippi Valley, and the present is the only species known in California. The *Serranoid* fish, previously alluded to, is *Stereolepis gigas*, Ayres, more commonly called the Jew-fish. Monterey Bay appears to be the most northern point ordinarily frequented by this fish, which attains the immense weight of from four to five hundred pounds, and is a most delicious food fish—superior, as I am assured by those who have tasted it, to any of the rock-fishes. Very rarely it has been taken in San Francisco Bay. The range of this species extends to New Zealand.

THE ROCK-COD OR ROCK-FISH.

Under these names are included the various species of *Chirus, Sebastichthys, Sebastodes, Ophiodon, and Scorpænichthys*, many of which are caught within the bay, others at various points along the coast, especially towards the north.

The genera enumerated belong to the old family *Triglidæ* or *Selerogenidæ*, the latter name meaning "mailed cheeks," and referring to the extension backwards of the suborbitals and their union with the preopercula. On account of the considerable structural differences which distinguished the sections or sub-families of this large family, it is now usually divided into several distinct families, and our rock-fish belong to three of these, namely: *Chirus* and *Ophiodon* to the *Chiridæ*, *Sebastichthys*, and *Sebastodes* to the *Scorpænidæ* and *Scorpænichthys* to the *Cottidæ* or Sculpins. The members of the genus *Chirus* may be readily distinguished from the others by their comparative smoothness, and the presence of several lateral lines of pores. *Sebastichthys* and *Sebastodes* have an armature of spines upon the top of the head and the edge of the preoperculum, and thirteen spines in the dorsal fin; *Ophiodon* has small scales, a smooth head, a scarcely spinous preoperculum, and twenty-six dorsal spines; while *Scorpænichthys*, like most of the species of the family *Cottidæ*, is scaleless and has a depressed head with various spines and flaps. The flesh of these fishes is firm and nutritious, but rather dry, lacking the delicacy of some of the *Pleuronectidæ* and the richness of the salmon.

Several of these species were described by Dr. Ayres, in the Proceedings of the California Academy of Science, volumes 1 and 2; and although, in some cases, his notes are antedated by those of Girard Pacific Railroad Report, volume 10, the Californian naturalist may still claim to be the first to introduce six of them to the scientific world. Two species observed by Dr. Ayres I have not yet observed in the markets; these are *Sebastichthys elongatus* and *Sebastichthys ovalis*. The first I am acquainted with only by the specimens in the Museum of the California Academy of Science; the second I have not yet recognized.

CHIRIDÆ.

All the fishes of this family have small scales, ctenoid or cycloid, a long, continuous dorsal, or two dorsals, and an elongated, rather compressed form. The head is spineless. Exclusively marine.

Chirus constellatus, Girard, Constellated; *Chirus guttatus*, Girard, Spotted—The fishes of this genus appear in the market in greater or less abundance throughout the whole of the winter, spring and summer. They are usually taken in the bay. Many of the fishermen and dealers call these fishes sea trout; others do not distinguish them from the various species of *Sebastichthys*—the names of rock-fish or rock-cod serving alike for all. *Constellatus* may be known by the more or less perfect circles of small round spots, inclosing a lighter area, that diversify its sides, while *C. guttatus* is covered with small yellow blotches, sometimes arranged in irregular rows. These light blotches become darker on exposure to the air. *Constellatus* may also be distinguished by the spotted pectoral fin. *C. pictus*, the painted sea trout, is not so often seen as the two previously mentioned, although it is taken in the bay. *C. nebulosus* is also sometimes brought to market, as the Academy of Sciences possesses a specimen bought there. *C. pictus* may be identified by the rich reddish-brown spots and blue cloudings upon its sides, and by the pectorals, alternately barred light and dark. *C. nebulosus* is dark above, lighter below, the two colors showing a tendency to form bands on the sides. All these fishes are peculiar in having several lateral lines along the sides instead of one, as is usual among fishes. The length of full-grown individuals is from twelve to sixteen inches.

Ophiodon elongatus, Girard, Green Rock-cod—This is one of the largest and commonest of our marketable fishes, attaining a length of over three or even four feet, and is usually in great part of a lively green color, spotted or clouded with light brown. But the coloration of the adults varies greatly. The brown markings sometimes cover almost the entire fish, and different shades of brown occur in the same individual. The young is spotted with round spots of a light yellowish-brown, and it was to the young that the name *Ophiodon elongatus* was originally given by Girard, who described the adult with the title of *Oplopoma pantherina. Ophiodon elongatus* was said to have a continuous dorsal, with twenty-seven spines and no membranous flap upon the forehead, while *Oplopoma pantherina* was characterized by two separate dorsals, the first with twenty-five spines, and by the presence of a membranous flap. Dr. Steindachner corrects this error (*Icthyologische Beitrage*, No. III.), and proves that the continuous dorsal and membranous flap are characters of the species.

The correct number of spines is twenty-seven, but the adult frequently comes to market in a dilapidated condition, with the spines torn apart from each other, or even broken away, and it is most probable that Girard described his *Oplopoma pantherina* from such a mutilated specimen. Young and half-grown individuals are common in the Bay of San Francisco, but the larger examples are taken in tolerably deep water, outside of the bay, especially in the vicinity of the Farallones. Steindachner gives the range of this species as from Sitka to Monterey. This is a highly carnivorous fish. The fishermen describe it as the terror of the inhabitants of the rocks; the other fishes hide for fear of it, and are often seized off the hooks by it.

Another *chiroid*, not usually called a rock-fish, is *Anoplopoma fimbria*, a species which, though rare in our markets, except in September and October, is of more common occurrence northwards, and occurs also along the northern coast of eastern Asiatic Russia. Examples sold here seldom reach a length of more than twelve or occasionally sixteen inches.

SCORPŒNIDÆ.

The sea-scorpions are easily recognized by their ctenoid scales, spinous heads and gill-covers, and single dorsal fin. The union of the dorsals and the presence of true scales, always spinous on their free margins, distinguishes this family from the *Cottidæ;* while the larger head, the armature of spines, the usually stouter body and the rougher scales, distinguish it from the *Chiridæ*. Exclusively marine; of wide distribution.

Sebastichthys flavidus, Ayres, Gill, Yellow Rock-cod—This is one of the most abundant of the rock-fishes, equaling in this respect *ruber* and *pinniger*. It may be known by the greenish-brown and yellowish-green tints of the back and sides, as well as by the third anal spine, which exceeds the second in length, instead of only equaling it, as in *Sebastichthys melanops*. The spines upon the top of the head are not large. In size it equals *Sebastichthys melanops*. Those brought to market are taken outside the bay.

Sebastichthys pinniger, Gill, Smooth Red Rock-cod—This species was first noticed by Ayres (Proceedings California Academy of Science, 11, 1862, p. 207), but was, by that ichthyologist, wrongly identified with the *Sebastichthys rosaceus* of Girard. It became, therefore, necessary to rename it.

Sebastichthys pinniger appears to attain a larger size than any of the other nearly related rock-fish, except *Sebastichthys ruber*, which it usually equals in length but not in weight, as it is of more slender proportions. In weight it seldom, if ever, exceeds fourteen pounds. It is not taken within the bay. In color it is far from uniform, the upper portion of the head and back being blotched with a darker red than the ground tint, inclining to brown. The spines upon the upper surface of the head are small and inconspicuous, and the paired fins long, the ventrals extending beyond the vent, and the pectorals to within four scales of the first anal spine.

Sebastichthys melanops, Girard, Black Rock-cod—This fish does not usually attain so large a size as *Sebastichthys ruber* or *Sebastichthys rosaceus*. It is one of the commonest kinds of rock-fish, occurring in the markets almost every day throughout the year. The back of this fish is almost black, inclining to purple, the fins are dark purple, and the sides blotched with purplish black. Besides those taken in the immediate neighborhood of San Francisco, large quantities are sent from Monterey and other localities.

Sebastichthys rosaceus, Girard, Pink-spotted Rock-fish—The species thus named is not the *rosaceus* of Dr. Ayres, who identified Girard's *rosaceus* with what has been proved to be a new species, the *Sebastichthys pinniger* of Gill; but it is identical with the *Sebastes helvomaculatus* of the former naturalist. It is smaller even than *Sebastichthys nebulosus*, not equaling it in length and of much more slender form. The three elongated pink spots along each side are constant, and at once distinguish it from every other species. In color it resembles *Sebastichthys ruber*. Though not so common as *Sebastichthys auriculatus* or *Sebastichthys melanops*, or even as *Sebastichthys nebulosus*, *Sebastichthys ruber*, or *Sebastichthys pinniger;* it is brought in in considerable numbers. In length it very seldom exceeds twelve inches. It is probable that this species is identical with *S. oculatus*, Val.

Sebastichthys nigrocinctus, Black-banded Rock-cod—This species is reddish-yellow, with five or six nearly vertical, broad, cross bands, and usually two or three short bands radiating from the eye; but these bands are much more developed in some specimens than in others. It is one of of the rarest of our edible fishes, as only single individuals are brought to the market at considerable intervals of time. It is not taken inside the bay. In size it is about equal to *Sebastichthys melanops* or *Sebastichthys flavidus*. There is no mistaking this fish, with its conspicuous black bands across a reddish ground, for any other fish in our markets.

Sebastichthys ruber, Ayres, Rough Red Rock-cod.—This, the largest of the genus occurring in our waters, is stated to reach, though rarely, a weight of twenty-five pounds. It is of a uniform bright red, very different from the brownish red mingled with orange red which forms the livery of *Sebastichthys pinniger*. In form it is stouter than *Sebastichthys pinniger* but less so than *Sebastichthys nebulosus*. It is usually taken outside of the bay, usually from deep water around the Farrallone Islands. It occurs also northward at least as far as Humboldt Bay. By the uniformity of the color, the abundance of supernumerary scales on the large scales, and the peculiar shape of the preopercular spines, this species may readily be distinguished from *Sebastichthys pinniger* as well as from *Sebastichthys rosaceus*, the latter of which strongly resembles it at first sight. The three pink spots of *rosaceus* are, however, a constant character by which it may be known from young individuals of *Sebastichthys ruber;* and the smooth surface of the head in *Sebastichthys pinniger* distinguishes it as readily from the same species.

Sebastichthys auriculatus, Girard, Black-shouldered Rock-cod—This is rather a small species, seldom exceeding eighteen inches in length, and is brought to the markets in great abundance, probably on account of its common occurrence in the bay. Not only does this species occur, together with two or three others of the smaller kinds of *Sebastichthys*, and the young of the larger kinds, in the deeper portions of the bay near the entrance, but it is also abundant along the eastern shore of the bay where no other species of the genus is found, probably on account of the admixture of fresh water from the Sacramento River. This fish can always be distinguished by a black mark upon each of the gill-covers, very obvious in the younger fish, and sufficiently distinct, though less clearly outlined, in older specimens. The general color is a dull reddish brown with cloudings of a darker tint upon the back and sides; these cloudings, like the black spot before mentioned, becoming more diffused and indistinct with increasing size and age. This is another of the kinds which must eventually become scarcer, unless some means be taken to prevent waste. Small individuals, four to six inches long, are brought to market in great numbers from various parts of the bay.

The lower jaw in *Sebastichthys auriculatus* projects but slightly, contrasting broadly with that of *flavidus*, and most of the other species of the genus.

Sebastichthys nebulosus, Ayres, Clouded Rock-cod—This is one of the smallest of our rock-fish, yet is heavier by far than individuals of other species of equal length, on account of the stoutness of its form. It seldom attains a length of more than eleven or twelve inches, though it occasionally reaches eighteen inches, and seven pounds is the greatest weight ever attributed to it. Some of the specimens have a broad yellow band along each side, and are also adorned with yellow blotches of variable form and size; but in others this band, which doubtless suggested to Girard his name of *fasciatus*, is absent, and the dark and light tints of the sides are mingled together without any approach to regularity or beauty. In this species the lower jaw does not project as in most of its tribe, but is even with the upper. It is one of the most abundant of the rock-fish.

Sebastodes paucispinis, Girard, Gill, Small-sealed Rock-fish—This species may readily be distinguished from all the species of *Sebastichthys* by the smaller size of the scales, as well as by the straight dorsal outline and the extreme elongation of the lower jaw, the tip of which extends upwards to the line at the top of the head, and forms part of its upper outline. The spines upon the head are very little developed. This is one of the rarest of our food fishes, occurring in our markets only at considerable intervals, and in small numbers. In color it is reddish brown on the back, as well as on the dorsal and caudal fins; the tint becoming lighter but more decidedly red on the sides and abdomen. In size it exceeds many of its relations, as most of those brought to market reach or exceed two feet in length.

COTTIDÆ.

Spinous dorsal shorter than the soft dorsals, separate body without true scales, but often with prickles or scale-like plates.

Scorpænichthys marmoratus, Girard, Large Red Sculpin, or Bullhead—Despite the absence of scales upon its body, this species is commonly styled a rock-cod. While its nearest relations, the smaller sculpins, or catfish, as they are often called here, are thrown away by the fishermen, this large sculpin is allowed a place among our food fishes. *A priori* one would expect the other sculpins to be good food, and I am assured by those who have tried them that they are; all they need is skinning before cooking. Although tolerably common within the Bay of San Francisco, and very frequently taken by the angling fraternity upon Oakland wharf and in similar situations, this species is only occasionally brought to market, and then only in small quantities.

Under the name of *Hemitripterus marmoratus*, this species was described by Dr. Ayres, in the Proceedings of California Academy of Sciences, vol. 1, p. 4.

Scorpænichthys marmoratus is sometimes called a rock-cod, at others a bull-head; the latter name being also applied to other *cottoids* with depressed heads. It reaches a length of two feet or more. Several smaller *cottoids* are brought to market occasionally, more by accident than design. These are *Hemilepidotus spinosus*, a species with four bands of scales; *Leptocottus armatus*, the common yellow sculpin of the Bay of San Francisco, *Aspicottus bison*, *Artedius lateralis*, *Artedius pugettensis*, and a species, probably new to science, which I have described under the name of *Artedius quadriseriatus*. None of these are used to any extent as food, yet *Leptocottus armatus* is sufficiently common in this bay to be so used, if the prejudice against its appearance could be conquered.

SCIŒNIDÆ.

In this family the body is compressed and rather elongated; dorsal fins, two sometimes slightly connected, the first consisting of not very strong spines, and less developed than the second, or soft dorsal; teeth of the jaws in villiform bands, none on the vomer, or palate; scales ctenoid, but not very strongly so. Other characters are a continuous lateral line, generally one or two anal spines; the presence in most cases of barbels, or pores, under the chin; bones of skull more or less cavernous; and usually a large air bladder. Chiefly marine.

Atractoscion nobilis, Ayres, Gill, Sea Bass—This is one of the most valuable of our food fishes, since it grows to a large size, and is of most excellent flavor. Its usual dimensions are those of an ordinary salmon, but it frequently attains a larger size, a large individual reaching a weight of seventy or even ninety-five pounds, and a length of five feet. It is taken in the bay, and at various points along the coast, north and south. Ayres states that Captain Scammon found it abundant as far south as latitude 27°. In our markets it is sometimes plentiful, but the supply is very uncertain, even when it is in season. During the months of November, December, and January, to February 20th, I did not meet with a single individual, but in October, and from March to September, it has been of tolerably frequent occurrence. "Sea Bass," boiled and baked, is a constant dish at the restaurants of the city, but examination shows that much of that sold at the cheaper restaurants is sturgeon. In color, it is of a clear grayish blue, with metallic blue and golden reflections on the fore part of the body, and on the head, when fresh; the sides are lighter. The first dorsal fin has ten spines; the second, one spine, and twenty-two articulated rays.

Genyanemus lineatus, Gill; *Leiostomus lineatus*, Ayres; the King-fish—This species was formerly common in the bay, but since its waters have been defiled with so much tar and drain refuse by our destructive imperfect civilization it has become scarce, and is now usually obtained outside. It is, in my opinion, one of the most delicate of our food fishes, and, fortunately, is still abundant, occurring in greater or less numbers in our markets throughout the year. In size it does not greatly exceed a herring, average individuals measuring six to eight inches in length. Ayres says "it seldom exceeds eleven inches." Other names for this species are little basse and cognard. The wavy lines of browner tint which run obliquely along the grayish-brown body are in many specimens not very obvious. By these bars and the obtuse snout, under which the lower jaw is received, this species may readily be known from the next.

Seriphus politus, King-fish.—This fish, known by the dealers by the same name as the last, but readily distinguishable from it by its longer head, much longer lower jaw, shorter spinous dorsal and more silvery tint, scarcely deserves, on account of its rarity, to be mentioned among our food fishes, yet is taken within the Bay of San Francisco. I have never seen more than one or two in the market at once.

LABRIDÆ.

This is the leading family of a group which, in consequence of the coalesence of the two lower pharyngeal bones into a single tooth-bearing bone, has received the name of *Pharyngognathi*, and has been by many naturalists raised to the rank of an order. As, however, examples of the union of the pharyngeal bones may be found among fishes differing widely from each other in other structural points, this single character is not now usually believed to be of ordinal value; yet the *Labridæ*, the *Embiotocidæ* and several other families nearly united in other respects, form a natural super-family or section of an order. The *Labridæ*, as their name indicates, are characterized by having the lips, which in most fishes are thin and inconspicuous, well developed and thick. The scales are large and cycloid; a lateral line is present, but in most cases is interrupted in its course, and the spinous dorsal varies considerably in its development.

This family is sparsely represented on our coast. *Pimelometopon pulcher*, Gill, *Labrus pulcher*, Ayres, is occasionally brought to market in the autumnal months from more southern points, but is rare. It attains a length of over two feet, and may at once be recognized by its conspicuous livery of black and red, the former occupying the head as far as the pectorals, as well as the posterior portion of the body, the latter a broad transverse band from the pectorals to behind the anal. The pectorals, ventrals, caudal and dorsal are black. *Oxyjulis modestus*, Girard, Gill, a smaller species, is of still rarer occurrence, but becomes commoner in the more southern parts of the State.

EMBIOTOCIDÆ.

Ever since the first discovery of these fishes they have been objects of great interest to ichthyologists, chiefly on account of their peculiar method of reproduction. While by far the greater number of the true fishes are simply oviparous, that is, deposit their fully formed ova upon the bottom of the river or sea which they inhabit, some few are ovo-viviparous, the eggs being retained in the interior of the ovary and hatched there. Prominent among these is the well known

Zoarces anguillaris, or viviparous blenny; but in the *Embiotocidæ* we have a family of considerable size, all the members of which bring forth their young alive and fully formed. The interior of each ovary is divided by highly vascular membranes into longitudinal compartments, in which the young are systematically arranged; and no better idea of the appearance of an ovary thus packed with living young can be formed than by comparing it with the interior of a pomegranate, the pips representing the young, and the partitions those dividing the ovaries. Only it must be remembered that there are of course no transverse partitions in the ovary of an embiotocoid, as in that case there would be no means of exit. The appearance, however, is similar to that of the fruit, as the longitudinal membranes form a fold between each embryo. Between the ventral fins and the vulva there is a scaleless space upon the abdomen, forming a sort of sheath or fold, usually concealed by the projection of the scales of the sides. The shape of these fishes is not unlike that of the sunfishes or pond perch (*Centrarchidæ*), or of the sheep's head and porgee of the Atlantic; but the scales are cycloid or smooth, and rather large; the lips well developed (in some cases excessively thick), and the mouth very extensible, characters which prove a rather near relationship to the *Labridæ* or Wrasse family. The cheeks are scaly, and a narrow sheath of scales extends along the base of the soft dorsal. During the winter months the supply of these fishes was comparatively small, and chiefly confined to the kinds which inhabit the bay, but during April and May the supply has been very abundant, the species constituting the bulk of the catch being *Embiotoca jacksoni*, *Embiotoca lateralis*, *Hypsurus caryi*, *Holconotus rhodoterus*, *Phanerodon furcatus*, *Rhacochilus toxotes*, *Damalichthys vacca*, and *Hyperprosopon argenteus*. Most of those brought to market are females, full of young, and it is safe to say that at least twenty perfectly formed young fishes are killed for every adult taken at this season. The greater part of the spring supply comes from the north of our bay, near Tomales Bay; and some of the kinds found in our own bay all the year round are not largely represented. Among these are *Amphistichus argenteus*, *Cymatogaster* (*Micrometrus*) *aggregatus*, and *Abeona minima*, the latter the "shiner" of the angling fraternity, and the only one of the marine species of the group which is too small to be of much value for food. As the habits of this tribe of fishes are not well known, I will only suggest the desirability, for the sake of ensuring the permanence of the supply of a group which is only second to the salmon in its importance as an article of food for the people of this coast, of some legislative regulations which may give the females a chance to perpetuate their race before they are taken. How to do this I do not venture to say, as I do not know whether many of the species are procurable at any other than the season of reproduction, and I here ask all who have leisure to investigate the matter, to endeavor to ascertain at what season the various species of this tribe seek the shallower water, and whether they are to be found at other seasons in such localities that they can be taken.

Unless some means is found of protecting some of the more useful and abundant of our fishes, so that they may have a chance to reproduce their kind; our supply of fish, even now too limited for the demand, will, in a few years, dwindle to next to nothing. Our bay will be "fished out" as many a river and bay in Europe has been fished out, and one of our most important sources of food supply will be dried up. The peculiar mode of reproduction of these fishes not only render them of considerable scientific interest, but the young, hatched perfectly formed, and able to take care of themselves from the moment of their exclusion from the oviduct, have many more chances in the struggle for life than those of ordinary fishes; and with a little care on our part it is probable that an abundant supply could be maintained. We take the ova of the shad and the salmon, and by careful watching and tending hatch the young, which we then put into the rivers to take their chance; but in this tribe of fishes nature does all this work for us, and all we have to do is to let the young fish get away safely, as far as we are concerned.

I have mentioned by name eleven species, but these are not all. About eighteen kinds are known, one of them a native of Japan, the others all from this coast; one, *Hysterocarpus traskii*, Gibbons, is found in the fresh waters of our State, but all the others are marine.

The Embiotocidæ are a difficult family to study, not only because of the anatomical peculiarities which need fuller investigation, but on account of the confusion into which the nomenclature has fallen. Various species were, about 1854, described almost simultaneously by Agassiz and by Dr. W. P. Gibbons, of Alameda. Shortly after, Girard, in the Pacific Railroad Report, described several species, most of them identical with those described by the two former naturalists. Each of these writers gave a different name to the same species; this was unavoidable in the case of the first two naturalists. But Girard, coming after the others, chose also to re-describe them giving at the end of his work on the family a list of Dr. Gibbons' species which he states he could not recognize. He who undertakes to write scientifically upon this group has now to disentangle the maze of synonymy, and also to determine which of the numerous genera have characters which entitle them to recognition, and all this means a great deal of hard and unattractive work.

These fishes are commonly known as "perch," although some of the species have been honored with distinctive titles.

Embiotoca jacksoni, Agassiz, the Pogy or Black Basse—The pogy, black basse, or black perch, as it is variously called, on account of a supposed resemblance to fishes not very nearly related, is perhaps the best known of the family. At the same time it is one of the most difficult to distinguish, on account of the difference of color between the male and female, and between the young and the adult. Thus the *Embiotoca cassidii* and *Embiotoca webbii* of Girard are only partially grown black perch. The female is of a deep dark purplish-brown, with the vertical fins and ventrals of a bluer purple; but the male is much lighter in tint. The young have transverse bands across the body, a peculiarity which is common to the young of the whole family, but persists in the adults of some species. These bands are in all cases darker than the ground tint. Some individuals have the vertical fins decidedly violet. There are four rows of scales upon the cheek. Girard gives the number of young in the two ovaries as about sixty. This species is tolerably common in the Bay of San Francisco, and abounds in Tomales Bay; and is brought to market more or less abundantly throughout the year. It is one of the largest of the family, attaining a length of fourteen or fifteen inches, and a weight of from three to four pounds.

Tæniotoca lateralis, Agassiz, Blue-banded Perch—By the peculiarity embodied in the English name I have ventured to apply to it, this fish may at once be known from the other species of the family. The sides are banded with numerous longitudinal stripes of purple, and the head is adorned with various bluish marks. Like *Embiotoca jacksoni*, it is found both in San Francisco and Tomales Bays. It attains very nearly as large a size as the former species, and it is brought to our markets at all seasons of the year, though less abundantly in the winter than in April and May. As in the last species, the young differ in their coloration from the adult, being usually lighter and more brightly colored, and this has been the cause of the description of nominal species.

Hypsurus Caryi, Agassiz, the Orange-banded Perch—This, one of the most beautifully tinted of the family, is either not found in this bay or is very rare there, as only occasional specimens occurred in the markets during the winter months. Large quantities of this species have been brought from Tomales and its vicinity during the months of April and May; it is not a large form, exceeding in this respect the species of *Hyperprosopon*, but falling far behind either of the previously mentioned kinds. The largest I have seen was not more than twelve inches long, and the average length is about ten inches. It may be at once recognized both by its coloration and by its form. The species most nearly resembling it in color is *Embiotoca lateralis*, but in the present species the blue streaks are mingled with orange, which latter tint predominates upon the abdomen, the back is richly bronzed; the dorsal, caudal, and anal are irregularly banded with orange and white; the pectorals are of light golden; there is a black blotch on the anterior part of the anal, and the ventrals are tipped with black. But the form of the body is still more distinctive. The anal fin is formed of fewer rays than in the preceding species, and these rays are crowded into a short space and directed horizontally backwards, their base being directed upwards at an angle of about 60° from the horizontal. The space between the ventrals and anal is thus longer than in the other *Embiotocidæ*, this, together with the short, horizontally, directed anal, and the straight line formed by the abdominal outline, give the fish a peculiar appearance. The teeth are few, four to six in the upper and nine to twelve in the lower jaw. All the examples I have seen in May were females with their ovaries full of young.

Phanerodon furcatus, Girard—Extremely abundant in the markets during the summer and autumn, the supply coming from Tomales Bay. This is one of the most uniformly colored of the *Embiotocidæ*, the prevailing tint being that of burnished silver. The older individuals are darker above, and the dorsal and caudal have a darker margin. The dorsal spines increase in length to the last, which is almost as long as the first ray; the anal is long and low, and the caudal peduncle narrow. *Phanerodon furcatus* seldom reaches a length of more than twelve inches, and as it is a slender and rather thin species, its weight seldom exceeds one pound.

Damalichthys vacca, Girard—In general form this species closely resembles the thick-lipped perch, but may at once be distinguished from it by the want of the thick lips. I first noticed its presence in the markets in the month of February, and from that time to October it has been tolerably abundant. Most of those I have seen were about a foot in total length and about four inches in width across the body; but the species attains a weight of from three to four pounds. In color it is slaty-gray, becoming more silvery on the sides and silvery-white below, without any conspicuous marks or bands. The second ray of the soft dorsal is twice the hight of the last and highest spine of the spinous portion of the same fin.

Rhacochilus toxotes, Agassiz, Thick-lipped Perch—This is the finest and largest of the tribe, attaining a length of sixteen or eighteen inches, and a weight of from five to six pounds. It can be at once identified by the great thickness and prominence of its lips, especially the lower lip, which forms a broad, continuous fold around the lower jaw. The greatest width is about a third of the total length. The caudal peduncle is long and the spinous portion of the dorsal fin much lower than the soft portion. The teeth are few, and in a single row. The coloration of the fresh fish is not conspicuous, as it is chiefly a bright silvery-gray, becoming darker and metallic on the back, with a reddish tinge posteriorly, and dark and dull on the top of the head. From April to September this species has been of tolerably common occurrence in the markets, though by no means so abundant as *lateralis*, *caryi* or *Hyperprosopon argenteus*. It is usually sold at a higher price than the other perch. Those brought to market in the months named are caught in Tomales Bay.

Micrometrus aggregatus, Agassiz; *Cymatogaster aggregatus*, Gibbons, Large Shiner—This is one of the kinds ordinarily found in San Francisco Bay, brought to market, though not in abundance, throughout the year, and frequently taken by anglers. It does not attain the dimensions of the *Embiotoca jacksoni*, *Embiotoca lateralis*, or *Rhacochilus toxotes*. The scales of this species are comparatively large, the lateral line containing only from forty to forty-four. The longest spines are longer than the rays of the soft dorsal, and the sides have eight or nine longitudinal bands, formed of black dots. The young have three or four vertical bands.

A still smaller species is the *Micrometrus minimus* of Gibbons, *Abeona trowbridgii* of Girard, and Shiner of the small boys, who usually contemptuously fling it back into the bay whenever they take it. Its presence in the market is only accidental, among the heaps of small flat-fishes or smelts.

Hyperprosopon argenteus, Gibbons, Large-eyed Perch—The large eye; the upward turned mouth; the lower jaw extending to, or even beyond, the horizontal from the upper margin of the pupil; the broad short body, the shape of the spinous dorsal, the fourth spine of which is the longest, and longer than the soft dorsal; the silvery color, and the black-tipped ventrals, render this easily recognizable from all the other *Embiotocidæ* except the rarer *Hyperprosopon agassizii*, *Hyperprosopon arcuatus*, and *Hypercritichthys analis*. The first of these is known by the absence of the black tips to the ventrals, and the presence of a black margin to the caudal; the second by the greater curve of the back, less depressed forehead, smaller eyes, and shorter lower jaw; and the third by the considerably smaller eye, more elongate body, shorter dorsal and anal, and the presence of a black spot in the middle of the caudal. The large-eyed perch is common in San Francisco Bay, and during the months of April and May is brought in large quantities from Tomales Bay. It is smaller than most of the preceding species, the length seldom exceeding nine or ten inches, and the weight about half a pound.

In this genus the teeth form a single row extending all around the lower jaw, and about half way along the upper, thus differing from

Embiotoca, *Hypsurus*, and *Rhacochilus*, which have only a few teeth in each jaw, and from *Micrometrus* and *Amphistichus*, which have a double row.

The present species, together with *Hyperprosopon agassizii* and *Hyperprosopon arcuatus*, differ considerably in form from the rest of the family, as the greatest width is contained in the total length to the tip of the caudal only two and a half times.

All these brought to market in May, so far as I have observed, are females, with the ovaries full of young; but this species is taken at all seasons of the year.

Holconotus rhodoterus, Agassiz, Red-fin Perch—This is another of the kinds which inhabit the Bay of San Francisco. It may be readily identified by the reddish color of the fins, while the shape of the spinous dorsal, which is highest in the middle, differs from that of all the other *Embiotocidæ* except those belonging to the genus *Hyperprosopon*, from which the smaller eye and more elongate form at once distinguishes it.

As is the case with most of the species of *Embiotocidæ*, the supply of this fish is very irregular. After weeks during which it either does not occur or is very rare, it will suddenly appear in the market in great abundance, forming a large proportion of the total catch of perch.

Amphistichus argenteus, Agassiz, Silver Perch—This is another of the species common in the bay. From *Micrometius aggregatus* it may be known by its much smaller scales, and by the persistence, in the adult, of transverse bands upon the body; and from *Hyperprosopon argenteus* by its smaller eye and more elongated form; and from *Holconotus rhodoterus* by the lower spinous dorsal. In length it seldom exceeds ten or twelve inches, and the largest individuals attain a weight of two pounds or a little more. The fifth dorsal spine is slightly longer than the last, which is a little shorter than the anterior articulated rays.

SPHYRÆNIDÆ.

Sphyræna argentea, Girard, the Barracuda—It is well not to be misled by English names. That of barracuda is applied not only to all the species of *Sphyræna*, of which there are several, but also to fishes of other families, and even other orders. In the rivers of South America the name is given to the *Sudis* (*Arapaima*) *gigas*, a soft finned, large scaled, fresh water, carnivorous fish. All barracudas, however, are fierce, rapacious fishes, and the one we are at present considering attains a length of over three feet, and a weight of from twelve to fourteen pounds. The form is slender, but it is nearly as thick as it is deep, and its jaws are armed with a formidable row of sharp teeth. When darting through the water it looks like a silver arrow. It is usually obtained south of the bay, and at the Farallones, but occurs at least as far north as Tomales. Its flesh is very good eating, so that if it devours our food fishes we may console ourselves by devouring it.

I am informed that this fish has never been known to occur in the bay. This fish may at once be recognized by its long, cylindrical shape, elongate head, cycloid or smooth scales; first dorsal fin of five spines only, the second spine highest, and second dorsal, of eleven rays, placed far behind the first dorsal. This species is the only representative on this coast of the family *Sphyrænidæ*, which consists of the single genus *Spæhyrna*.

SCOMBRIDÆ.

The five following species belong to this family, as defined by the older writers, including the *Stromateidæ*, *Carangidæ*, and other tribes not represented here. None of them are caught, except rarely, near San Francisco, and most are highly prized, both on account of their rarity and their quality. In all the scales are very small and smooth, or are absent; the color is steely blue. lighter below, and the caudal is broadly bilobate. The three first noticed are true *Scombridæ*, and have several small finlets behind the dorsal and anal fins.

Scomber colias, Spanish Mackerel—The *Scomber diego* described by Ayres (Proceedings California Academy of Science, vol. 1, 1857, p. 92) has been proved by Steindachner to be identical with the long known *Scomber colias* or Spanish mackerel of the European seas. Steindachner states that it occurs frequently on the coast of the Galapagos Islands, and wanders in small shoals along the Californian coast as far as San Diego, also that single individuals occur near San Francisco. Thus this species and *Albula vulpes* are among the few fishes which inhabit both the Atlantic and the Pacific Oceans. On one occasion only, in April of the present year, I found this species in the market in tolerable abundance, and it has again occurred in September. Those which were then exposed for sale were small, not above eight inches long, and came from Monterey Bay. The identity of Ayres' *Scomber diego* with *Scomber colias* has been confirmed by a comparison of Ayres' original specimen with the diagnosis given by Günther. (Catalogue of Fishes, British Museum, II).

From the two succeeding species this may be readily known by the presence of only five finlets behind the dorsal and anal fins; by the spinous dorsal of seven spines; and by the irregular reticulated dark lines upon the back.

Sarda lineolata, Girard—This, like all the Pacific Coast Scombridæ, is not very often brought to the markets of San Francisco, except in September and October. They are usually caught in Monterey Bay.

Günther (Cat-fish, British Museum, II, 368) considers this species to be identical with the *Pelamys chilensis* of Cuv. and Val. It attains a considerable size, a series of four specimens lying on the stalls measuring respectively two feet, two and a quarter inches; two feet, two and three-quarter inches; and two feet, three and a half inches, from tip of snout to fork of caudle fin. The caudle fin cannot be said to be crescentic, as stated by Girard, since its posterior margin form two sides of an obtuse isosceles triangle. The sides and belly are silvery, becoming bluish-black towards and on the back, and five or six obliquely longitudinal bands of the darker tint run along the sides.

From November to the end of May this species has not occurred in the markets. Appearances indicate that this and some other *Scomberoids* take a run northwards in the autumn, and thus reach the San Francisco markets from Monterey. The patch of larger scales behind the pectoral fin, and the oblique, darker streaks upon the sides of the body, serve to distinguish this species from the succeeding one, but the dealers distinguish them also by the texture of the flesh, which is softer in this species than in *Chriomitra concolor*. The first dorsal has eighteen spines, and there are eight finlets behind the dorsal, and seven behind the anal.

Chriomitra concolor, Lockington—In October and November of the past year, my attention was drawn to a *Scomberoid* which somewhat resembled the *Pelamys* (Sarda) *lineolata* of Girard, but examination proved not only that it was not that species but that, on account of the absence of a corselet, or patch of large scales behind the pectoral fin, and the want of teeth on the vomer, or palatines, it must be made the type of a distinct genus.

Very few of these fishes were brought in during the autumn—by no means sufficient to supply the demand, for it is in great repute among rich gastronomists, and fetches a high price. Its flesh is said to be far firmer and better than that of *Sarda lineolata*, from which it may be readily distinguished by the characters mentioned above, but also by the absence of the darker, oblique streaks which diversify the flanks of the latter fish. Although most of the individuals sold here are brought from Monterey, I am informed that stragglers have been caught as far north as Tomales. Those which I have seen have averaged about two feet in total length to the tip of the caudal lobes. There are seven or eight finlets behind the dorsal, and eight behind the anal fin. There are seldom more than two or three of this species in the markets at once.

Poronotus simillimus, Ayres, Pompino—This species was first described by Dr. Ayres (Proceedings California Academy, vol. 2., page 84, figure on page 85) in December, 1860, and accompanied by a tolerable outline figure. Dr. Ayres states that in the course of seven years he only saw three or four specimens; but this year at least it is far more abundant, as I have seen as many as thirty or forty on the same stall on many occasions. As with the other *Scomberoids*, the examples brought to this market are usually caught in Monterey Bay, which appears to form the northern limit of many species of fishes, crustacea, and echinoderms. The Italian fishermen call this species "pompino," and this must be accepted, in the absence of any other, as its English name. I am informed that a fish called "pompino," on the Atlantic coast, is considered to be the most delicate of all fishes. This is *Trachynotus carolinus*, a very different species. Our "pompino" is also highly prized as a delicate morsel, and is one of the dearest fishes in the market. This species has been more or less abundant throughout the whole of the winter and spring, but during part of the time the catch has been principally composed of very small individuals, not above three or four inches long, which certainly should not have been caught at all. Most of these small ones are, if I have been rightly informed, taken in the Bay of San Francisco, to which this species is an occasional visitant, and the high price the species commands tempts the fishermen to catch all they can find. An adult pompino measures from eight to ten inches in length. This fish may be identified at once by the total absence of ventral fins, while its thin, broad, oval body, bright steely color, and dorsal fin with only a single spine, are other conspicuous features. It is covered with rather small, smooth scales.

Trachurus symmetricus, Ayres, Horse-mackerel—Authorities differ as to whether this fish is peculiar to this coast or is identical with the *Trachurus trachurus* of Linnæus. Dr. Günther identifies it with the latter, thus making it identical with the European horse-mackerel, which, if his view is correct, is a widespread form, common to both great oceans. Professor Gill does not agree with this view. He says (Proceedings Academy of Natural Science, Philadelphia, 1862, p.

26): "They can be readily distinguished at first glance. The California species has the flexure (of the lateral line) very abrupt and oblique, and the pectoral fin equal to the length of the head before the preoperculum." This fish is only sent occasionally to our market, usually from Monterey, but when it is present it is in greater abundance than any of the other *Scomberoids.* Occasionally it visits the Bay of San Francisco, for the single specimen (seventeen inches long) on which Dr. Ayres founded his species, was taken there, and the dealers assure me of its occasional occurrence. Those sent from Monterey are seldom as large as Ayres' specimen. It is not valued so highly as either of the previous species. From all the other fishes brought to this market it may be readily known by the series of keeled scales along the center line of the hinder part of the body.

BLENNIIDÆ.

This family, as originally composed, consisted of a heterogeneous assemblage of fishes with little in common except a greater or less tedency to an elongate form, with more or less elongate dorsal and anal fins; and ventrals which are either jugular (in advance of the pectorals) and composed of fewer rays than usual, or are absent altogether. They are, by Professor Gill, divided into several families, among which are the *Anarrhichadidæ* or wolf-fishes: large, ravenous fishes with strong teeth and no ventral fins; *Blenniidæ* or true Blennies, with ventrals and a long, dorsal fin, formed partly of spines, and partly of soft rays; *Stichæidæ* or Snake Blennies, with a dorsal composed of spines only, and a compressed, thin body; *Xiphidiontidæ* or Gunnels, which differ from the last, among other things, in the absence of a lateral line, and the presence of one ray only, in the ventrals; and *Cryptacanthidæ,* which have the cleft of the mouth nearly vertical, no ventrals, and the dorsal rays all spinous.

To the first of these belongs *Anarrhichthys felis,* Girard, a long snake-like fish, with a large, heavy head—so heavy that if it hang on one side of the hand while the body is on the other, it will draw the body after it—and very strong teeth. It is sometimes brought to market, and attains a length of four to eight feet. The contents of the stomach of a large specimen brought to market, June 10th, consisted entirely of the tests of our common cake-urchin. Another *Blennoid,* occasionally seen in the markets, and reaching a length of more than two feet, is *Cebidichthys cristagalli,* Ayres, a brownish olive fish, with two or three purplish violet bands upon the cheeks, and a crest upon the head (*Cebidichthyidæ,* Gill). The other *Blenniidæ* brought occasionally to market, are quite small fishes, but *Apodichthys flavidus,* Girard, would make up for its small size by its abundance, if it were at all sought for as an article of food. It attains a length of about a foot, and is frequently found under stones above low-water mark.

A species of the *Batrachidæ,* or toad-fishes, *Porichthys porosissimus,* the only one found on the coast, is common in the bay and at various points up the coast, and is sometimes brought to market in the summer, at which season it resorts to the tide-pools under the rocks, to deposit its ova. It attains a length of about sixteen inches, and may be recognized by the lines of silvery pores on the under side of the the body, and the absence of scales.

All the above fishes are used as food by the Chinese of San Francisco.

ATHERINIDÆ.

A small family, with two distinct, small dorsal fins, the first composed of five to seven weak spines; ventrals abdominal; teeth feeble; scales smooth; a silvery band along the sides.

Chirostoma californiensis, Girard, Smelt—This species, together with the following, and three species of small Salmonoids mentioned further on, are all sold in the markets and peddled in the streets of San Francisco under the name of smelt. All are taken in the bay, and all are abundant, but the two *Atherinidæ* are far more so in individuals than any of the Salmonoids sold under that name, and exceed them still more in quantity. The present species is much larger than its relation, reaching a length of seventeen inches, and may be distinguished by its larger head, more slender form of body, larger mouth, and the central position of the first or spinous dorsal. It is probably the most common of the fishes of the bay, *Atherinops affinis* alone rivaling it in this respect. Both species are excellent eating, but in this respect are inferior to the salmonoid smelts sold with them. The two *Atherinoids* may be readily distinguished from the salmonoids by the presence of two dorsal fins, the first very small, placed about in the center of the length of the back, and formed of spines of stiff rays, the second rather larger, and separated by an interval from the first. Their prevailing color is light green, but a silvery band runs along each side.

Atherinops affinis, Ayres, Steindachner—In *Atherinops affinis* the dorsal is nearly its own length further back than in *Chirostoma californiensis*, the form of the body is much stouter, the head proportionally smaller, the mouth smaller, the fins larger, and the flesh firmer. Dr. Ayres states that this species never exceeds eight inches in length, and this size must be but rarely attained, as the specimens I have seen in our markets seldom pass six inches, while *A. californiensis* usually exceeds twice that length. Like the last species it is extremely abundant throughout the year. A large proportion of the small fishes wasted by being thrown upon the shore by the fishermen belong to this species; but mingled with them are the young of the last species, quantities of *Engraulis ringens*, and a proportion of true smelts and small flat-fishes. The Chinese dry these small fry in large quantities, on matting spread in the sun, turning and tending them carefully. When dried they are gathered up, trodden down into large sacks, and exported to the Flowery Kingdom. Not only is the mouth proportionally smaller than in the preceding species, but there is only a single row of teeth in the jaws, each tooth two-pointed.

MUGILIDÆ.

Mugil mexicanus (?), Steindachner—Several specimens of a species of *Mugil*, evidently very close to the above species, if not identical with it, have found their way to our markets in the months of September and October. All of them were taken near Santa Cruz, in the Bay of Monterey.

The specimens examined agree with *Mugil mexicanus* in the number of scales in the lateral line, and of rays in the vertical fins; in the length of the latter, in the produced upper caudal lobe, and in the proportions of the body and head. And I should not hesitate to pronounce them to be of that species were it not that Mr. B. B. Redding, one of the Fish Commissioners for the State of California, has informed me that about three years ago he placed several (I believe about forty) individuals of a *Mugil* from the Sandwich Islands, in the Sacramento River, and it is, therefore, possible that the specimens obtained may be some of these, or their young. I suspect this because the shad introduced from the East finds its way, in considerable numbers, to Monterey Bay, instead of dutifully returning to the place of its birth, and this *Mugil* may have acted in a similar way; also because the specimens agree tolerably well with the diagnosis of *Mugil cephalotus*, given by Günther. The inter-mandibular spaces agrees pretty well with Günther's figure of that of *Mugil cephalotus*, but it is still nearer to Steindachner's figure of *Mugil mexicanus*. As this is a mullet, it is of course tolerably good eating, but it must be remembered that it is not nearly related to those famous delicate fishes, the red mullet and the surmullet, which were so highly prized by the Romans that they fed them in aquaria, but to the gray mullet. The first mentioned fishes belong to the *Mullidæ*, and are provided with a barbel; the latter and our Californian fish to the *Mugilidæ*, which has no barbel and no teeth worth speaking of. From October to the end of May I have only seen a single specimen, which occurred near the end of April.

The *Mugilidæ*, of which this species is the only representative on this coast, are very near to the *Atherinidæ*, forming with that family Gill's suborder *Percesoces*, or perch-pikes. There are two perfectly distinct dorsals, the first of four weak spines; the ventrals are abdominal; the head is broad; the teeth are extremely feeble, or wanting, and there is no silvery longitudinal band.

SUBORDER ANACANTHINI.

In this suborder all the fin rays are soft and articulated; the scales are cycloid; the ventrals jugular, that is, in advance of the pectorals; and the dorsal and anal fins very long, often divided into two or three portions. The suborder includes several families, the most important of which, to the human species, is the *Gadidæ*, to which the cod, haddock, hake, whiting, and other well-known Atlantic fishes belong.

Other families, members of which are found on this coast, and occasionally brought to the markets of this city, are the *Brotulidæ*, *Ophidiidæ*, and *Lycodidæ*, each of which furnishes a single species.

The Ophidioid of our markets is *Ophidium taylori*, Girard, a small fish attaining a length of about ten inches, and inhabiting the sandy beaches at various points along the coast. It is eel-like in form, with continuous vertical fins, a pair of long bifid filaments (representing ventrals) attached to the base of the tongue between the two rami of the lower jaw; and small teeth on jaws, vomer, and palatines.

The Lycodoid, *Leurynnis paucidens*, Lockington, is still more elongated, but has a much larger mouth and narrower gill openings. Teeth are present upon the jaws only, the ventrals are very small, and the vertical fins continuous.

Both these fishes are excellent as articles of food, and have the additional advantage of the almost entire absence of small bones, but they are not brought to market in sufficient abundance to be of much value.

The Brotuloid is *Brosmophycis marginatus*, Ayres, Gill, a very rare fish, as only two or three specimens occur in the course of a season, but larger than either of the preceding. It may at once be recognized by the continuous margin of red formed by the conjoined dorsal, anal, and caudal fins. Red-fin would be a good English name for it. It attains a length of more than twelve inches, and is less slender than the two preceding species. Of its gastronomical qualities, I cannot speak.

The Gadidæ are represented at this point by the two following species only, as the true cod does not occur so far to the southward.

Merlucius productus, Ayres, Gill, Californian Whiting—Of this species I have as yet seen only a few exceeding fourteen or eighteen inches in length. Dr. Ayres, its first describer, speaks of it as by no means common, but mentions "a few specimens, all taken at the same time, and from eighteen to twenty-four inches in length." Some of the dealers inform me that it has been scarcer of late years. Certain it is that, except in the autumn, it is of rare occurrence in our markets.

From *Microgadus californicus* this species may at once be recognized by the large size of the mouth and the union of the two posterior dorsals into one fin, each portion of which, as well as the first dorsal and the two portions of the anal, is highest near the center of its length.

Microgadus californicus, Gill; *Morrhua proxima*, Girard, Tomcod—This little fish is abundant throughout the year, and I am assured that when it is properly cooked no fish of the coast surpasses it in flavor. It may be at once known from every other fish by the three separate triangular dorsal fins, the first highest and all highest anteriorly, the small mouth, and the short barbel below the chin. In length it seldom exceeds eight or nine inches. It is common in the Bay of San Francisco.

SUBORDER HETEROSOMATA—FLAT-FISHES.

No tribe of fishes is probably so well known to that large class of naturalists whose love of nature takes a practical turn, who like best those creatures which taste best when boiled or fried, as the flounders, flat-fishes, or *Pleuronectidæ*. Apart from their attractiveness to the sense of taste, they have one peculiarity which challenges the attention of the most uninterested observer of this world's living wonders—they have both their eyes placed on the same side of the head. If a little more attention be paid to this obvious feature, it will be found to be even a greater peculiarity than was at first supposed. The flounders are not the only fishes which have their eyes on the same side of the body; the skates, rays, torpedoes, and their relations are in this respect similar. Where then, lies the great difference between these two classes, for no one would confound the two, even at the first glance? Simply in this, that the skate and ray tribe are flattened downwards, the side which is uppermost is the proper upper side, and the eyes are placed in their usual position with regard to the other parts of the head; whereas, in the flat-fishes the body is flattened out sideways, the fish swims on one of its sides, instead of on the proper under-surface; and the eye which of right belongs to the side which is beneath, has twisted round out of its place, and is situated on the same side with the other, unsymmetrically with the other parts of the head. Of course this is not the only difference between the skates and the flounders. There are far more important anatomical differences, but it is one of the most obvious outward distinctions between two tribes which, though widely separated in other respects, resemble each other in having the eye so placed as to look upwards, in their thin flat bodies, colored upon the upper side only, or principally, and in their habit of residing at the bottom of the sea; their uncolored surface resting on the bottom. Again, the flat-fishes are not the only fishes which have a very wide body, flattened laterally; the sunfish is also very deep from dorsal to anal; and some of the mackerel tribe are even more excessively compressed; but these and all other laterally compressed fishes, except the flat-fishes, swim in the usual manner, dorsal fin uppermost, and the eyes are in the usual position—one on each side.

It will be readily understood that the two eyes cannot be brought round to one cheek without great distortion of the bones of the skull; many of the bones on the colored side are cramped in their development, squeezed into a narrow space, out of the way of the encroaching eye; while some of the bones of the blind side are correspondingly enlarged, filling up, by their lateral extension, the place where, so to speak, the eye ought to be. Now, a distortion of this importance, if it were not of universal occurrence in the whole tribe, would be considered a monstrosity; and it became an interesting question to ascertain at what point in the life history of these fishes the distortion commenced. Surely so very important and radical a modification of the skull and bones of the head must commence at the very first beginning of the formation of the fish, before it is hatched from the ovum. But it has lately been conclusively proved that this is not the case. Professor Alexander Agassiz has watched the development of young flounders, and has proved that when first hatched, they resemble other fishes in the position of the eyes and the symmetrical form of the head; and that the distortion is the result of habit, which habit again increases the distortion, precisely as claimed by the advocates of what is usually called "evolution." That is to say, the young fishes seek the bottom of the water, yet strive to use the lower eye. By the continued effort to use this, the soft structure of the head is affected, and an oblique upward view is gained. This renders the fish less fitted than before for locomotion in the usual manner, and more adapted for keeping at the bottom, which it accordingly does, with the result that the eye becomes more and more twisted till it at last has passed clear over the dorsal ridge of the animal, and makes its appearance on the same side with the other eye. This side is, in some species, the right, while in others it is the left side. All this takes place while the creature is young, before the bones are hardened It would appear that in some cases, the eye literally passes through the head.

But it must be remembered that the bones of fishes are, as a whole, much softer than those of reptiles, birds, or mammals, and therefore much more capable of yielding to impressions from the outside without the destruction of the life of the organism.

Thirteen species of these fishes are now known to occur on this part of the coast, and all of them are brought to our markets more or less frequently. All these species belong to the family *Pleuronectidæ*, or flounders, from which the *Soleidæ*, or soles, are distinguished by the absence or rudimentary condition of the pectoral fins. Although no real sole occurs here, all the species except the two known as "halibut," that called "turbot," and another which the dealers know as "bastard turbot," are sold in the market under the name of "sole."

Hippoglossus vulgaris, Halibut—The rarest of these species is a true halibut, or *Hippoglossus*, which Professor Goode, the well known ichthyologist, believes to be identical with the Atlantic species *Hippoglossus vulgaris*. *Hippoglossus vulgaris*, an Arctic species, extends therefore along the coasts of Europe, eastern North America, and Northwest America, reaching on this coast the latitude of San Francisco, which is probably its most southern point. It is occasionally taken at the Farallone Islands, but as yet I have only seen a single specimen brought from thence. To the northward, about Vancouver Island, it becomes abundant, as it is also in Alaska. This fish is greatly esteemed as an article of food, and, on account of its rarity, it has, until lately, commanded a high price. The individual above mentioned was retailed at fifty cents per pound.

A schooner has recently been fitted up expressly for the purpose of bringing fresh halibut, packed in ice, from Puget Sound, or its vicinity, to San Francisco. The trip down occupies about four days, and the fish, entire, with the exception of the viscera, arrive in perfectly good condition. Two trips have been taken this year, and halibut has been retailed at from ten to fifteen cents per pound. The three largest halibut taken weighed respectively 180, 190, and 220 pounds, and their weight with the viscera would probably be about one-fifth more. The individual weighing 190 pounds measured 7′ 1″ in total length, and had three or four rows of teeth in the front of each jaw.

Psettichthys melanostictus, Girard, Sole.—As most of the fishermen and fishmongers of San Francisco and its neighborhood are Europeans, principally Italians and other Mediterranean peoples, with a sprinkling of English and New Englanders, they have given to such fishes as they have thought worthy of a vernacular title names which properly belong to species found in the Mediterranean and Atlantic, and frequently, but distantly, related to their Pacific namesakes. In pursuance of this rule, the name of "sole" is applied to several species brought to the markets of San Francisco, and among these the most common is the one named above. It does not appear, so far as I have been able to ascertain, to be caught in any great quantity within the Bay of San Francisco, but is usually taken outside the heads and at the Farallone Islands. The greater portion of those sold in the markets are about ten inches in length, but some attain a length of eighteen inches or even more. This species may be readily distinguished from all the other flat-fishes of our coast by the form of the dorsal fin, the first rays of which, situated on the top of the head, are higher than those immediately succeeding them, and by the dark gray color, produced by black spots, just large enough to be recognized as such by the naked eye, upon a ground of a lighter tint. These black spots are not conspicuous in individuals just taken from the water, which are of a more uniform and far lighter color, but become so after a few hours exposure to the air. The interorbital space varies in width, apparently increasing with age, though not always in proportion to the size of the individual. The number of rays in the dorsal and anal fins is, as is not unusual among long-finned fishes, subject to considerable variation, the number of dorsal rays ranging from seventy-eight to eighty-eight and that of the anal rays from fifty-eight to sixty-two. The proportions of the body also vary considerably, some being much narrower than others, but the species is always more elongated than *Hippoglossides jordani*, with which it is often confounded. The scales are not smooth, as described by Girard, but ciliate upon their free margins; and there is also running along, close to and parallel with the dorsal outline of the anterior part of the body, a second or "accessory" lateral line, a feature which is repeated in several of the small-mouthed flounders. In the stomach of a specimen seven and a quarter inches long were the half-digested remains of two anchovies (*Engraulis ringens*).

Hippoglossoides jordani (nov. sp.), Sole—This species is tolerably common in the markets of San Francisco, but appears to have hitherto escaped description, probably on account of its considerable external resemblance to *Psettichthys melanostictus*, Girard, from which, however, it may be readily distinguished by the much larger eyes; the form of the dorsal fin, which increases toward the center instead of commencing with rays higher than those immediately succeeding them (as is the case in the latter species); by the narrower interorbital space; and, still more readily, by the color, which is more uniform and lighter, the black points upon the scales, which are conspicuous to the naked eye in *Psettichthys melanostictus*, not being evident unless viewed with a lens. In large specimens the head has a reddish tinge. The largest I have yet seen measured eighteen inches in length. In common with *Psettichthys melanostictus* this species bears in the markets the name of "sole," and many of the fishmongers, who readily distinguish from each other most of the species of flat-fishes, do not appear to discriminate between these. So far as I have been able to learn, it is taken outside the bay in the same localities with *Psettichthys melanostictus*. In form of body, size, structure of the mouth, scales, and lateral line, this species resembles the species previously mentioned; and the distinctions between them would, in fact, be considered only of specific value were it not for the presence in *Psettichthys melanostictus* of an accessory lateral line along the dorsal outline, a character which this species does not possess. A technical description of this fish has been published in the Proceedings United States National Museum, September, 1879, p. 73, and I have taken the liberty to name it after the distinguished icthyologist, Professor D. S. Jordan, who has done more than any other American naturalist to increase our knowledge of the fresh water fishes of the United States, and who is at present engaged in preparing an Ichthyology of the United States, which will include the fishes of the Pacific Coast.

Those dealers who distinguish this fish from *Psettichthys melanostictus* do not appear to rate its value as an article of food equal to that of the latter; but the two kinds lie together on the stalls, and are sold for the same price. The scales are ciliate or rough upon their hinder margins, but less so than in the previous species.

Paralichthys maculosus, Girard, Monterey Halibut—This species attains a large size, larger than that of any other of our flat-fishes except the true halibut, *Hippoglossus*. Individuals of from 30 to 40 pounds weight are comparatively common. The two largest I have yet seen weighed respectively 43 and 58 pounds, and I am told that it reaches from 60 to 70 pounds. The example weighing 58 pounds measured nearly five feet in total length. Small individuals of this species, having the eyes and color on the right side, were described by Girard as *Paralichthys maculosus*. Subsequently Dr. Ayres described, under the name of *Hippoglossus californicus*, a form which proves to be really only the adult of Girard's species. As his examples were sinistral in their coloration, it was until very lately believed that these two names represented two distinct species, but it has now been proved that they are one species, which is sometimes dextral, sometimes sinistral. The row of bluish spots along the dorsal and abdominal outlines, which doubtless suggested the name *maculosus*, is present in the adult, but is less distinct; and the caudal fin, said to be convex in *maculosus*, and concave in *californicus*, proves to have a sinuous outline, the central and exterior rays produced beyond those lying between them. The Monterey, or "bastard" halibut, as it is sometimes called, may be known from our other *Pleuronectidæ* by its short head; elongate, regularly ovate form; small scales, with a row of long, narrow accessory scales along their free margin; and by the bold, abrupt arch made by the lateral line above the pectoral fins. In numbers it is not common compared with the two previously-mentioned species, but makes up in bulk during the months it is in season. Throughout the winter and early spring it is scarce, but large individuals become tolerably abundant in April, and throughout the summer the young are sometimes sold as "turbot." Those brought to market usually come from Monterey or its vicinity, but it also occurs northwards, at least as far as Tomales Bay, and southwards to San Diego, whence Girard's type was procured.

Citharichthys sordidus, Günther; *Psettichthys sordidus*, Girard, Left-handed Flounder—This species is brought in considerable numbers to the markets of San Francisco, and can be readily distinguished from every other kind occurring on this part of the coast by the combined characters of eyes and color on the left side, lateral line almost perfectly straight, bony, ridge-like interocular space, and insertion of the ventral fin of the colored side upon the ridge of the abdomen, instead of on the same level with that of the blind side. As is the case with many other species, the number of rays in the dorsal and anal fins is not constant. In color this fish is of a dirty yellow or yellowish-brown, with each scale margined with blackish and the fins speckled with the same. The scales are smooth and very flexible. As the dealers do not appear to have given it any title, I have here named it by its most obvious characteristic, namely, the presence of the eyes and color on the left side; not that it is the only species possessing this character, but because, so far as I have been able to observe, it is constant in possessing it, while the Monterey halibut and the species usually known here as the "flounder" (*Platichthys stellatus*) are sometimes dextral, but in other cases sinistral. The left-handed flounder does not usually attain the dimensions of any of the previously described species, the usual length of those brought to market being only from ten to twelve inches. It is not taken within the Bay of San Francisco. How far its range extends either northward or southward I do not know, but in the latter direction it certainly reaches to San Diego, as a dried specimen, sent to the Smithsonian Institution by Dr. J. G. Cooper, furnished Professor Gill with the type of his new genus, *Metoponops*.

Glyptocephalus zachirus (Lockington, Proceedings United States National Museum, September, 1879, p. 83)—This hitherto unnoticed species of flounder owes its specific name to the great length of the pectoral fin of the right or colored side of the body. This fin is much longer than the head and about equal to one-fourth of the total length of the fish, but it can scarcely be of much value to locomotion, as only one or two rays are thus excessively lengthened, the others falling off rapidly on each side. This character alone is sufficient to distinguish it, not only from its nearest relation on this coast, *Glyptocephalus pacificus*, hereafter mentioned, but from every other species of flounder, and it is further characterized by the blunt, rounded form of the front part of the head, a character not shared to anything like an equal extent by any other of our flat-fishes. It also differs from its congener in the presence of a spine in front of the anal fin. The color, like that of many other of our fishes, is rather difficult to describe. It is a more or less dark gray ash, formed by minute black points upon a lighter yet colored ground. On the blind side there are also numerous black points, but they beset a white ground, producing a light gray tint.

The two *Glyptocephali* of this coast may thus be distinguished from the other flounders by the coloration of their blind side, as well as by their exceedingly elongate form. As this fish has no name in our vernacular, it may be as well to call it the "long-finned flounder." The long-finned flounder is not taken in our bay, and I have not yet been able to ascertain the locality from which it is brought. I first noticed this species about March 21st, and from that date to July it has been almost regularly present, but always in small quantity. I have not observed it in August or September. The largest that I have yet seen measured $14\frac{5}{8}''$ in length and $4\frac{1}{4}''$ in depth, the length of the head being $2\frac{5}{8}''$ and that of the pectoral fin $3\frac{1}{16}$. The dorsal of this individual contained 98 rays and anal 81 rays; but some individuals have as many as 186 dorsal and 89 anal rays. I have experimented on the edibility of this fish, and pronounce it one of the best, if not the best, of our flat-fishes, an opinion in which I am borne out by others who have tried it.

Glyptocephalus pacificus, Lockington—On visiting the market, on the 13th of March, I found, among the small flat-fishes exposed for sale, two small specimens, which, from their excessively elongated form and the considerable thickness of the body, seemed new to me. These fishes were between eight and nine inches long, their width was but a little more than a fourth of their length (a most remarkable proportion for a flounder), and the short head was less than the greatest depth; the mouth was very small, the lateral line quite straight, the scales minute and quite smooth, and the color a dark, blackish gray, with the tips of the fins darker, approaching black. The dorsal fin, as might be expected from the proportions of the fish, was exceedingly elongated, and contained many more rays than that of any other of our flat-fishes, the two specimens having respectively 102 and 104 rays. The anal fin was correspondingly elongated, and contained 84 rays in one and 87 in the other. The teeth, twelve in number in the lower, and nine or ten in the upper jaw, were broad and flat, with a cutting edge, like the incisors of a mammal, and formed a close row along the jaws on the blind side and in front, while there were none upon the colored side. It agrees in the length of the dorsal, elongate body, smooth scales, and straight lateral line, with the genus *Glyptocephalus*, and has been described as *Glyptocephalus pacificus* in the Proceedings of the National Museum, September, 1879, p. 86.

This species cannot certainly be brought to market during the winter, as, though I was a regular visitor of the markets from September to March, I never met with it. From the date of its first occurrence until September this fish has usually been in the market, and during the summer has been comparatively abundant. The largest I have seen measured nearly twelve inches in length, and this is probably almost the limit of the growth of the species. In flavor it is excellent, but scarcely equal to its congener *Glyptocephalus zachirus*. This species and the preceding are taken in seines, in tolerably deep water, four or five miles from Point Reyes. The fishery is only two years old.

Platichthys stellatus, Platichthys rugosus, Girard—This species, commonly called flounder, is by far the most abundant of the kinds brought to our market, and attains a larger size than any other, except the bastard halibut (*Paralichthys maculosus*) and the *Hippoglossus*. The eyes and color are sometimes upon the left side, at others upon the right; a circumstance that has rather bothered naturalists, while it has served as a basis for fanciful theories among the fishermen. It may be readily distinguished by its short broad form, the width exceeding somewhat the half of the length (excluding the caudal fin); by the presence, instead of scales, of scattered, rough, stellated tubercles; and by the black bands upon dorsal, anal, and caudal fins, four upon the first, three upon the second, and three upon the last, all of them running in the direction of the rays. It is of wide distribution, occurring along the coast of Kamtschatka, and from thence extending by Behring's Straits, Alaska, and British Columbia southward to San Francisco. How far it may occur to the south of the latter point does not appear to be known with certainty, but as it is evidently a northern form, it is not unlikely that its southern limit will be found to be near Monterey, at which point there is a mingling of northern and southern forms, resulting in an extremely rich local marine fauna; rich not only in species of fishes, but in *molusca*, *echinoderms*, and *cœlenterates*. The flounder occurs within the Bay of San Francisco, and is brought to market not only from thence, but from various points outside of the heads; some are even sent from Humboldt Bay, but it is said that these are far coarser than those obtained elsewhere, with comparatively less meat, and fetch a much lower price in the market.

Those taken here attain a weight of eight, ten, or even twelve pounds, but those sent from Humboldt Bay are much heavier. In this species the number of the dorsal and anal fin rays does not appear to be subject to so much variation as in many other flat-fishes. Many of the fishermen believe that they know the reason why this fish is sometimes colored on the right, and sometimes on the left side. It is, they are confident, caused by the moon, and depends upon the side illumined by that orb at the time of fecundation. A far more intelligent theory, but one which yet lacks proof, is held by the fishermen and dealers, to the effect that those colored on the left side are females, while those colored upon the right side are males. The same theory is held in the case of the Monterey halibut. The old Russian naturalist, Pallas, first described this species, which was described by Girard in 1865. The identity of Girard's form with that of Pallas was noted by Gill (Proceedings of the Philadelphia Academy of Natural Science, 1862, p. 281), and by Günther (Catalogue of Fishes, British Museum, vol. IV, p. 443).

Pleuronichthys guttulatus, Girard, Turbot—This fish, the "turbot" of our markets, is one of the commonest of our flounders, but is usually of small size. Occasionally, however, individuals are taken weighing as much as five pounds, and measuring eighteen inches in length. The color alone is sufficient to distinguish it from all the other species. On the colored side it is, when quite fresh, of a dark olive green, sometimes blotched with irregular whitish spots. By exposure to the air the color deepens to nearly black. The underside is opaque white, like white lead, but along the margin of the head, from some distance above the eye, and continuing to the anus is a border of bright gamboge yellow, broadest and brightest upon the snout and lower jaw. Sometimes the whole of the under surface is yellow. It is a very broad species, in this respect rivaling and even exceeding *Platichthys stellatus* (the "flounder"), the width being nearly or quite half of the breadth. Another characteristic may be found in the teeth, which, instead of being a single row, form several rows, a character shared only by one other of our flat-fishes, *Pleuronichthys cœnosus*, which differs widely in the color, as well as in having the dorsal fin continued downwards along the blind side of the head, and in the very much larger eyes. The number of rays in the dorsal varies from 66 to 72, and those in the anal from 47 to 54, a range which, had the two extremes fallen into the hands of two different naturalists, might well have led them to make two species. Nor has this fish, short as has been its literary history, escaped from a synonym. It was first described by Girard (Pacific Railroad Report, vol. 10, p. 152), who attributed to it 67 dorsal and 47 anal rays, and gave its color as "greyish, or lead, sprinkled all over with black dots and whitish spots." In 1862 Dr. A. Günther re-described it, under the name of *Parophrys ayresii* (Catalogue of Fishes, British Museum, vol. IV, p. 456), yet admitted *Pleuronectes guttulatus* as a species. The insufficient description of Girard was doubtless the cause of this error. Girard's specimen came from Tomales, and I am informed that it is in the neighborhood of Tomales Bay that most of the turbot brought to market are procured. This fish is much esteemed, and always commands a high price.

Pleuronichthys cœnosus, Girard—This is a rare species, and evidently inhabits deep water, since the eyes of those I have seen protrudes from their sockets, through the sudden change from pressure at the depths where they reside to that of the surface. There are three characters about it which render it impossible to confound it with any other species: the very large eyes, which equal or exceed in diameter one-third of the length of the head, from the tip of the snout to that of the gill covers; the very short, snub snout, scarcely projecting beyond the protuding eye, and the singular course of the dorsal fin, the front part of which, instead of ending upon the dorsal ridge somewhere over the eyes, as in other species, curves over at that point to the blind side of the fish, and continues downwards along that side till it reaches a point level with, and not far from, the end of the maxillary or upper jaw. About eight rays are thus twisted over to the left side. The color also, a uniform warm reddish-brown, is very distinctive. The teeth, like those of the last species, (*Pleuronectes guttulatus*) are in several rows, and in the form of the body and fins the two kinds are also much alike.

Girard's original description was drawn from a single specimen, the only one he had seen. It is taken near the Farallones. The left or eyeless side is not always colorless, but has frequently several dark brown spots or blotches. The dorsal fin is occasionally carried further down on the blind side than is mentioned above, while in other cases only four rays are twisted over. During the winter this species did not occur in the market, but on the 26th of February one of the first of the season was brought to me, and since then it has gradually become more abundant until May, during which month it was as plentiful as *Lepidopsetta bilineata*, itself a rather rare species, also brought from the Farrallones.

Parophrys vetalus, Girard, Sole; Diamond Flounder—This is another of the common flat-fishes of our markets, and is grouped with several others under the name of sole. It may be recognized by its elongate, narrow head, with the upper eye placed upon the dorsal ridge, so as to look dorsally as well as laterally, by its elongate, rhombic form, the outlines of the posterior portion of the body being nearly straight, and by the development of the teeth upon the blind side only, where they form a single row. In color it is usually of a uniform reddish ash, but some of the younger individuals are irregularly spotted with darker blotches. On the blind side it is creamy-white. The number of rays in the dorsal and anal fins varies from 74 to 86 and from about 54 to 68 respectively, a variation which has probably been the cause of the description of the nominal species, *digrammus* and *hubbardi*, by Günther and Gill. Those brought to market are from eight to fifteen inches long, and occasionally a little larger, but the species does not appear to attain the weight of *Psettichthys melanostictus* or *Hippoglossoides jordani*, as it is much more slender in form. It is usually taken outside the bay. As a food fish, according to my judgment, as well as that of those dealers who distinguish it, it is inferior to the two species just mentioned.

Lepidopsetta bilineata; Platessa bilineata, Ayres, Mottled Flounder—The first description of this fish will be found in the Proceedings of the California Academy of Sciences, vol. 1, p. —. It is one of the numerous forms described by Dr. Ayres, and has always been one of the rarest and least known of our fishes, very little having been added to our knowledge of it since Ayres wrote. It may be readily known from every other kind found here by the following characters: Many of the scales upon the body are ctenoid; that is, beset upon their hinder edges with spinules; those on the cheeks are tubercular or roughened with bluntish points upon a large part of their surface; the form is regularly oval, the width of the body almost equal to half of the total length, and the color a quite light yellow with irregular white spots.

As in so many other of the more nearly related flat-fishes, the teeth, which are in a single row, are not equally developed on the two sides of the jaws, but are principally upon the blind side. The eyes are large, forming $\frac{2}{7}$ of the length of the head. This species is only occasionally brought to the markets, where, with several species previously mentioned, it bears the name of "sole." Those brought are usually of tolerably large size, from fourteen to fifteen inches long, and are caught at or near the Farallone Islands, though probably not in such deep water as *Pleuronicthys cœnosus*, since the eyes do not protrude, as is usually the case with the eyes of fishes suddenly brought up from deep water. On account of the spots upon its surface, I have given it the name of "mottled sole," or rather, mottled flounder. As a food fish it is excellent, yet is not considered equal to *Psettichthys melanostictus.* The lateral line, or row of pores which runs along the body from the head to the tip of the caudal fin, makes a bold, semi-circular arch over the pectoral fin; and there is, as in the three preceding species and the one following, an accessory line of pores running from some distance along the dorsal margin. This accessory lateral line is subject to curious modifications in its length and in the form of its anterior branches. The whitish blotches upon the colored side often form a series along the dorsal and abdominal margins.

Lepidopsetta umbrosa; Platichthys umbrosus, Girard—This species is most nearly related to the mottled sole from the Farrallone Islands

(*Lepidopsetta bilineata*), sharing with it the characters of rough scales and lateral line considerably arched above the pectoral fin. From that species it may be very readily distinguished by its color, which is of a dark uniform slaty brown, and from all other species by the combination of the two characters first mentioned, together with its regularly ovate form and small, quite laterally-placed eyes. It does not appear to be very common, as there are rarely above two or three specimens among a miscellaneous heap of flat-fishes, and the usual size does not exceed ten or eleven inches in length. From its small size and comparatively unfrequent occurrence it cannot be considered as of great value from an economic point of view. It is sold along with other species as "sole," and fetches the same price. The extent and boldness of the arch of the lateral line varies greatly.

SUBORDER ISOSPONDYLI.

This suborder is the *Physostomi* or *Malacopteri* of Cuvier and the older naturalists, minus the *Nematognathi* or *Silurians;* the *Haplomi* (pike-toothed minnows, etc.), and the *Eventognathi* or carp-like fishes. The fins are without spines (except one or two in dorsal or anal), the ventral has no spine, the scales are cycloid, the head is naked, and an adipose fin is present behind the true dorsal in some, while others have a serrated abdomen. The families, genera, and species included in this suborder are more numerous than those in any other, the *Acanthopteri* alone excepted, and among these families are two which, in their value to man, probably exceed any other, namely, the *Salmonidæ* and the *Clupeidæ*.

Of the remaining families one only, the *Synodontidæ*, sends a member to our markets in the person of *Synodon lucioceps*, Ayres, which is not improbably identical with *Sonodon* (Saurus) *fœteus*, Linn, a species known to occur upon the Pacific coast of Panama. In September and October, 1878, numerous specimens of this species occurred in the market, most of them eight to ten inches in length, but one individual reached seventeen and three-fourths inches. It is occasionally taken in the bay.

SALMONIDÆ.

The *Salmonidæ* are by far the most important group of fishes on this coast. The species of greatest value belong to the genera *Oncorhynchus, Salar, and Salvelinus.* These will not be treated of here. The single species of *Coregonus* that is known to inhabit the fresh waters of the State is not brought to market, so the only salmonoids remaining for our notice are the small marine fishes forming the group of the *Microstomatidæ.* All the *Salmonidæ* have an adipose fin; the maxillaries enter into the formation of the lateral part of the upper jaw; the belly is rounded and without serratures, and the air bladder is large and simple.

Hypomesus olidus—This delicate fish is, at first glance, similar to the following species, but the mouth is very small, the end of the maxillary bone reaching only level with the front of the eye, while in *Osmerus thaleichthys* it reaches to the back of the orbit. The head also is somewhat smaller. But this fish, when fresh, can be most readily distinguished by the transparency of its flesh, which, of course disappears entirely in preserved specimens. The silvery band along the sides, which is found in all the four species, and is probably the cause of their being grouped together as smelts, is particularly bright in this fish. This species has been tolerably abundant in our markets from October to August. In size it is usually somewhat larger than *Osmerus elongatus* or *Osmerus thaleichthys*, attaining a length of about eight inches.

Osmerus thaleichthys is really the nearest representative of the smelt of Europe, having the peculiar, pleasant smell that suggests the name in that species, which is also a kind of *Osmerus.* It may readily be distinguished from the two species of *Atherinidæ, Chirostoma californiensis*, and *Atherinops affinis* by the want of spinous rays on the back, by the adipose fin, by the absence of the bright green tint, which is replaced on the back by a dull, greenish olive, on which a diamond pattern is traced by rows of minute dark dots that fringe each scale, and by its smaller size. From *Hypomesus olidus* it may easily be known by the comparatively large size of the mouth and less transparent appearance. It is usually from five to five and a half inches in length. Its form is stouter than that of *Hypomesus olidus*, the flesh is soft in texture, and the pectoral fins reach very nearly to the origin of the ventrals. This form, like the last, has been present in the markets throughout the year in variable quantity.

Osmerus elongatus, Ayres—Among the fishes described in the early days of the California Academy of Sciences, by Dr. W. O. Ayres, was a species belonging to the smelt or *Osmeroid* group of the salmon family. A short description, unfortunately too short and incomplete for identification, was published in vol. 1, p. 17, of our Proceedings. Girard, in the Pacific Railroad Report, vol. 10, states his belief that Ayres' species is identical with the small-mouthed smelt of this coast. (*Argentina pretiosa*, Girard; *Hypomesus olidus*, Pallas, Gill). Examination of the small salmonoids brought to this market proves, however, that there are three species. One is Girard's small-mouthed species; another Ayres' *Osmerus thaleichthys*, described and figured in vol. 2, p. 62 of Proceedings of the Academy, while the third is almost certainly the *Osmerus elongatus* of the latter authority.

It is not easy for the unpracticed eye to tell these species apart, yet the differences are obvious when once recognized and are of a constant character. In this species the form of the body is more slender and elongated than in either of the other smelts, the dorsal fin is constantly farther back on the body, the lower jaw is long, resembling in this respect Ayres' other species, but differing from it in its straightness, that of *Osmerus thaleichthys* being curved upwards, and the profile of the top of the head differs from that of the last named form in the greater elongation and more pointed form of the snout. The dentition is strong, teeth being present on jaws, tongue, and palatines, the largest upon the front of the tongue. The dealers are able to distinguish the three species apart, trusting as much to the difference in the texture of the flesh, as evident to the touch, as to the variation in appearance. In alcoholic specimens this distinction is of course lost, and the species are harder to distinguish than when fresh. This may account for the union of two species under one name by Girard, though I believe it more probable that he never saw Ayres' species.

Among the heaps of small fishes sold for fry may usually be found all the three species of salmonoid smelts, the anchovy (*Engraulis ringens*), and small individuals of the smaller species of mullet-like smelt (*Atherinops affinis*).

CLUPEIDÆ.

This family as originally constituted comprised a large number of soft-finned fishes without an adipose dorsal, with the lateral margin of the upper jaw formed by the maxillaries, which are usually in three pieces, and with rather large scales. The sections of this large family have been lately raised to the rank of families, and are distinguished by very obvious features; thus the true *Clupeidæ* or herrings have the abdomen compressed to a sharp edge, which is set with a row of plates forming serrations; the lateral line is absent, and the teeth either very small or altogether wanting; the *Engraulidæ* or anchovies have the abdomen rounded, the upper jaw much longer than the lower, which is toothless, the mouth large, and the sides with a bright silvery band: while the *Albulidæ* or lady-fishes have a rounded abdomen, the upper jaw rather the longer, both jaws set with bands of villiform (velvet-like) teeth, and the roof and floor of the mouth covered with pavement-like patches of coarse granular teeth. These *Clupeidæ* are represented upon our coast by at least four species, three of which are of sufficient importance to rank as food fishes.

Albula vulpes, the sole member of the *Albulidæ*, and in many respects a very singular species, is a widely distributed fish, occurring in both the great oceans. Single individuals occasionally find their way to this market, probably from Monterey Bay.

Clupea mirabilis, Girard, Herring—This species may be known from the succeeding one by the projecting lower jaw, deeper and thinner body, and by the absence of conspicuous striations upon the gill-covers. It comes into the market in September and continues in season until late in the spring. North of Puget Sound it is said to occur throughout the year, and shoals visit various points upon the coast of California during the rainy season. The business of curing the fish is not extensive, and the dried fish is said to be inferior to that of the Atlantic herring, though it is probable that the inferiority is mainly in the method of preparation.

Clupea sagax, Jenyns, Sardine—This is a thicker, less deep, and somewhat longer fish than the last, the jaws are equal in length or nearly so, and present no trace of teeth, and the operculum has conspicuous radiating striæ, descending towards the sub-operculum. The form of the ridges on the upper surface of the head is also very different. The colors are exceedingly intense in the fresh fish, bluish-purple predominating, and there is a row of dark spots along each side. It is in season during the summer and winter, and is taken in the Bay of San Francisco.

Engraulis ringens, Jenyns, Anchovy—A species exceedingly common in the bay, and extending along a great part of the Pacific Coast of America. By the large mouth, with the upper jaw projecting beyond the lower, the present genus may be at once known from *Clupea*, and the present species is the only one of the genus which I have yet recognized in our markets. Although so near to the highly esteemed anchovy of Europe this fish does not appear to be in great favor, judging from the large number which are wasted by the fishermen, but it is at least useful as forming a large proportion of the food of the flat-fishes; if I may judge from the fact that I have found it in the stomachs of three species of that tribe. As the *Pleuronectidæ* live on the bottom, I presume that the anchovy is also an inhabitant of the lower strata of the water. Abundant though this species is, it is not cured or preserved in any way, but I am told that an abortive effort in this direction was once made.

SUBORDER EVENTOGNATHI.

The *Eventognathi* of Professor Gill, or *Cyprinidæ* of the older authors, are chiefly distinguished by the total absence of teeth upon jaw, vomer, or palatines, the only teeth they possess being those upon the pharyngeal bones at the entrance of the æsophagus. They are without a spinous dorsal or anal spine. The scales are cycloid, and in many cases of large size; there is no adipose dorsal fin, and the surface of the head is without scales. They are inhabitants of fresh water, and occur in both the eastern and western hemispheres. The family *Catostomidæ*, or suckers, is almost peculiar to America, and several of its species occur in California, although but one is brought in sufficient quantity to the markets of this city to be worthy of mention as a food fish.

Species of the true *Cyprinidæ* abound in the waters of this State, and several are brought to market with tolerable frequency; others more rarely. None of them, however, are very highly prized for food.

The *Catostomidæ* are distinguished by a mouth opening more or less downwards and furnished with conspicuous fleshy lips, the intermaxillaries, and by lower pharyngeal teeth in a single series—numerous, closely-set, comb-like, across the bone. There are no barbels, and the air bladder is large, divided into two or three portions by transverse constrictions.

The *Cyprinidæ* are without the thick, fleshy lips which characterize the last family; the pharyngeal teeth are few in number, rarely more than seven on each side, but often in two or three series. Barbels are often developed upon the lower jaw, and the air bladder is usually divided into an anterior and a posterior lobe.

Gila grandis, Ayres, Girard, Pike—This, as Ayres enthusiastically remarks, "is by far the finest fish of its family known to inhabit the waters of this continent."

It did not occur in the markets of this city in October, November, or December; but from January 6th, when I first observed an individual 2′ 9½″ long, until the end of May, has been tolerably abundant. The largest measured by Ayres was three feet long, but he reports examples weighing thirty pounds, and I have been told that it sometimes approaches four feet in length.

The name "pike," under which it is now generally sold, is as great a misnomer as that of "salmon trout," which Ayres gives as a dealer's name. The absurdity of both names will be evident to any one who remembers that both pike and salmon have a mouth liberally supplied with teeth, while the *Cyprinidæ* are all literally toothless as regards the mouth, their only teeth being on the pharyngeal bones in the throat. But the shape of the head, depressed in front, recalls that of the pike. It is a handsome fish, dark greenish gold on the top of the head, and the same, but lighter, on the back, and still lighter behind the dorsal fin, the color fading on the sides to silvery with golden reflections, and on the abdomen to plain silvery.

As the largest species found east of the Mississippi, *Semotitus bullaris*, rarely attains, according to Professor Jordan, "a weight of three or four pounds, and a length of nearly eighteen inches," it is evident that the present species is a giant among the minnows.

Pogonichthys inæquilobus, Girard, Split-tail—This species has been brought to market in tolerable abundance during the spring in company with *Catostomus occidentalis, Orthodon microlepidotus*, and *Gila grandis*. It may at once be known by the great length of the upper lobe of the tail fin, which projects considerably beyond the lower and has suggested the name of "split-tail," by which it is known in the markets.

Orthodon microlepidotus, Girard, Fan-tail—This is another of the more abundant *Cyprinoids* of our markets, brought in company with the three previously mentioned species. It attains a length of thirteen or fourteen inches. In color it is metalic greenish gold above, the top of the head dark olive green, with iridescent suborbitals, sides bright metalic silvery, lower surface silvery white. The surface of the head is crossed by a complex system of rows of pores, the caudal fin is large and fan-shaped, and the scales are remarkable from their small size.

Siboma crassicauda, Girard, which may fitly be named the thick-tail, is of occasional occurrence, as is also *Lavinia exilicauda*.

Catostomus occidentalis, Ayres, Western Sucker—This species is tolerably abundant in our markets at certain seasons, the supply being obtained from the Sacramento or its tributaries. Jordan (Bulletin United States Natural Museum, vol. 12, p. 172) mentions its occurrence in Green River, Wyoming, and says of its habitat "streams west of the Rocky Mountains, probably generally distributed." It is the only *Catostomoid* I have yet seen in the markets, and I did not observe its occurrence there until February, since which time the supply has been tolerably regular. The usual size of those brought here is from twelve to sixteen inches long. The scales are of variable size, increasing in size from the head backwards, so that the largest are upon the caudal peduncle and the smallest on the back, just behind the head. The scaleless head has a well-developed system of pores. In color it is not a very dark olivaceous above, with bluish silvery reflections, becoming lighter posteriorly. Each scale of the dark colored portion is darkest around its edges, rendering the pattern of the scales very distinct. The color fades into silvery on the sides, and silvery white below, with metalic reflections, most evident on the base of the caudal.

SUBCLASS GANOIDEI.

The fishes constituting this subclass vary immensely in structure, so much so that almost every genus constitutes a family, and every family is equivalent to an order; so much so that our leading systematists are divided in their opinions as to the limits of the subclass, and have weighted the world with arguments to prove that the curious mud-fishes (*Lepidosiren* and *Protopterus)* of South America and of the Gambia belong to it, and vice versa; and so much so that some have even suggested the dismembering of the subclass, considering the differences in structure among its members to outweigh the resemblances. All agree, however, in the importance and great extent of the structural peculiarities of each group; although the characters they possess in common are two only, the arterial bulb (of the heart) with several rows of valves, and optic nerves which do not simply cross, but form a chiasma. In common with the sharks and rays, they have heterocercal tail, that is a tail with the upper lobe, containing a prolongation of the vertebral column, longer than the lower, which is developed below it like a second anal fin; the air bladder differs in structure in the various groups, and the bony or ganoid enamelled plates which characterize some of the more typical form are wanting in others.

The only ganoid fishes found on this coast belong to the *chondrostei* or cartilaginous ganoids, or, which is the same thing, to the family *Acipenseridæ* or sturgeons. The skeleton is cartilaginous, five longitudinal rows of bony shields run along the elongate, subcylindrical body; the toothless mouth is a transverse slit on the under side of the head, in the same position as that of the shark; in front of the mouth are four barbels; and the dorsal and anal fins are set far back. There are no gill rays or branchiostegals; a large air-bladder, and the intestine has a spiral valve. The species are numerous; three or four occur on this coast, but only one is brought to our markets in quantity.

Acipenser brachyrhynchus, Ayres, Sturgeon—This is the only species of sturgeon which is brought to market in abundance, as the fishermen have a prejudice against the long-nosed or green sturgeon, *Acipenser acutirostris*, Ayres, which is abundant in the bay and the rivers and creeks flowing into it, asserting that it is poisonous. *Acipenser brachyrhynchus* is always in season, and always abundant, the weight of its flesh sold in the markets probably exceeding that of any other single species, excepting, perhaps, *Oncorhynchus quinnat.* It attains a very large size. On February 25th of this year I measured an individual 9′ 9″ long, the weight of which was 427 pounds. But even this was exceeded by a specimen brought to the California Market Christmas, 1878, measuring nearly twelve feet in length and weighing about 600 pounds. Examples of this size are of course rare. Caviare is manufactured in considerable quantities from the roe. Dr. Ayres describes a third species, *Acipenser medirostris*, but I have not yet recognized it.

SUBCLASS ELASMOBRANCHII.

The animals belonging to this class are commonly called fishes, but are distinguished by so many peculiarities of structure that they may be regarded as a subclass. This subclass contains the sharks, the rays, and the *Chimœroids,* examples of each of which groups may be found upon our coast.

In these fishes the skull is formed of cartilage alone, and no membrane bones (such as the parietal, frontal, etc.) are developed in relation to it; the gills are not free: the branchial openings are slit-like, and, (except in the *Holocephali,* or *Chimœroids*), several in number, there are no scales, but the external hard parts are what is known as placoid, composed of calcified papilla; and the eggs are few and large; some are ovo-viviparous. The minute structure of these placoid points or scales is precisely the same as that of teeth, which are also dermal in their origin. In the *Holocephali* the upper jaw and its suspensorial cartilages are wanting in a separate condition, as the parts representing them are united into a continuous cartilaginous plate, which is continuous also with the skull itself; and the branchial clefts are covered by an opercular membrane, so that the opening is single; but in the sharks and rays, which form by far the largest order, the upper jaw and the suspensorial cartilage are distinct from each other, and are moveable upon the skull, and there are several gill openings. The teeth are usually numerous, whereas in the *Chimœras* they are not more than six in number.

There is no doubt that the sharks and rays are good for food; they may not be so delicate as a flat-fish or a salmon, but they would furnish an acceptable and wholesome addition to our food stock. One species, *Raia binoculata*, the common skate of our coast, is habitually eaten; the Chinese eat other species; the poor people along the seacoast of England eat dog-fishes; shark's fins are a delicacy in China. If the prejudice against them could be removed, the consumption of these destructive fishes would aid greatly in reëstablishing the balance of life in the waters. What chance have our more prized fishes to perpetuate their race, when, in addition to the numerous enemies they previously had to contend with, man comes with his small-meshed nets, kills twenty young for every adult he needs for food; and in addition to this, artificially keeps up a colony of sea-lions at the entrance of the bay, while he neglects to take or kill the destructive sharks and rays, or to thin the schools of porpoises that revel in fish slaughter. Not that it would be advisable to destroy the colony of sea-lions which form one of San Francisco's greatest attractions, but it needs judicious thinning.

The commonest species of sharks found in the bay and its neighborhood are *Triacis semifasciatus*, the striped or tiger shark, which may readily be known by the dark stripes that descend from the back towards the belly, and which attain a length of more than five feet. *Mustelus*, Gill, a smaller species of uniform color; *Hexancus indicus*(=*Notorhynchus maculatus*, Ayres,) with seven gill openings instead of the usual five, and very peculiar many-cusped teeth; and *Rhinobatus productus*, Ayers, with very large pectorals, approaching the skates in form, but with the hinder part of the body shark-like. *Squatina angelus*, the angel-fish or monk-fish, of singular form and forbidding aspect, with a mouth that is terminal instead of underneath the head, and large pectorals, is occasionally taken.

Of rays, besides the common skate, we have *Rhinoptera vespertilio*, Ayres, a species with a thick head and an array of flat six-sided teeth, fitted together with all the regularity and closeness of a tesselated pavement. As this form has a wicked-looking serrated spine on its long tail, it is commonly called the sting-ray or stingaree. This is the species which, more than any other of its class, commits depredations on the oyster beds so industriously planted along the shores of our bay. A species of torpedo is sometimes met with, but is rare. Of the curious *Holocephali*, so called because the cartilage of the head is all in one piece, we have *Chimœra colliei*, Bennett, *Hydrolagus colliei*, Gill, a species which is distributed widely along the Pacific coast, and has occasionally been taken near San Francisco.

Raia binoculata, Girard, Skate—This alone, among the numerous rays and sharks which inhabit the bay, is brought to market regularly as an article of food. It is a very near relation of *Raia batis*, but the spines upon the head differ from those of that species. Many specimens have on each pectoral fin a large sub-circular black ring enclosing a black spot of similar form, but this is by no means constant, since though present in some examples eighteen inches or more across the fins, it is often wanting in much smaller specimens. A parasitic *Lernean* is sometimes attached to the ventrals. The skate is abundant in the bay, and is also taken at various points along the coast.

CLASS MARSIPOBRANCHII.

Under this name are included the lampreys or lamprey eels, and the myxines or hags, two tribes which differ from other fishes so widely that naturalists consider them a separate class. The body is long and worm-like, without a trace of the paired fins, pectorals and ventrals, which are the homologues, be it remembered, of our own limbs; but with the vertical fins, dorsal, anal, and caudal, more or less developed. But the greatest structural differences lie deeper. The whole class has an incompletely developed skull, without a trace of a lower jaw; the mouth is a round opening formed for suction, and the gills are purse-shaped, usually seven on each side. There is only a single nasal opening, which is central. In the *Petromyzontidæ* or lampreys the branchial sacs and openings are seven on each side, the intestine has a spiral valve, and the nasal duct is a blind sac, not penetrating the palate; the mouth is armed with horny teeth, which rest on papillæ. The young of these fishes differ considerably from the adults, and were formerly described as distinct genera. In the myxines the mouth is surrounded by barbels, the intestine is without a spiral valve, and the nasal duct penetrates the palate.

None of this group are usually brought to the markets of this city, but as the rivers of California contain several species which are known as "eels," and largely eaten in some localities, they need mention among our food fishes. Eel River, in Humboldt County, is named from the abundance of these lampreys, which are highly esteemed. The species known are *Lampetra plumbea*, Gill =*Petromyzon plumbeus*, Ayres; and *Entosphenus tridentatus*, *epihexodon*, and *astori*. A Myxinoid, *Bdellostoma stoutii*, Lockington, with ten teeth in the first, and nine in the second row, occurs also in Eel River, and a small example, presumably of the same species, was caught in the Bay of San Francisco.

LIST OF THE PRINCIPAL FISHES FOUND IN THE MARKETS OF SAN FRANCISCO BETWEEN OCTOBER FIRST, EIGHTEEN HUNDRED AND SEVENTY-EIGHT, AND SEPTEMBER THIRTIETH, EIGHTEEN HUNDRED AND SEVENTY-NINE.

The succeeding list is necessarily very incomplete, and is offered with apologies, as a commencement only, and a prelude to a more thorough catalogue. The reasons for its incompleteness are:

First—The fact that the writer had not, when the list was commenced, identified some of the known species, or detected the presence of species he has since described.

Second—The inability of the writer to be in the markets every morning early. The fish from Tomales, and places near the bay, arrive about 12:30 P. M., those from Monterey and more distant parts, about 4:30 P. M. The writer has visited the markets twice or thrice a week on the average, usually about 12:30 P. M. At that hour the mackerels and other fish from the south are usually all sold off, and it is probable that several of the rarer fishes occurred more frequently than he is aware of.

It must be remembered that the list refers only to the comparative abundance or scarcity of the various species in the markets, and, therefore, at least in the case of such fishes as the *Blennioids*, *Cottoids*, etc., not in great repute as food fishes, furnishes no index for their abundance in the waters. Several kinds which occurred on one or two occasions only, and were then only present by accident among other fishes, are omitted from the list.

Reference: a—tolerably abundant; b—scarce, never many on the same day; ab—occurring seldom, but abundant when present. The letter *a* does not necessarily indicate that the species is abundant, but simply that several specimens were seen on several occasions during the month.

As it was not until the latter part of the year covered by this list that I examined the two species of herring (*Clupea*) sufficiently to distinguish them at sight, I have marked with an *?* those months in which I think it likely that they occurred.

The English names given are, when printed in ordinary type, those by which the species is known among the dealers; when printed in *italics* they are proposed by the writer.

FISHES IN SAN FRANCISCO MARKET.

SCIENTIFIC NAME.	ENGLISH NAME.	1878.			1879.								
		October	November	December	January	February	March	April	May	June	July	August	September
PERCIDÆ.													
Archoplites interruptus	Sacramento River Perch					a	a	a	a	a	a	a	a
Stereolepis gigas	Jew-fish								b	b	b		b
CHIRIDÆ.													
Chirus guttatus	*Spotted Chirus*	a	a	a	a	a	a	a	a	a	a	a	a
Chirus constellatus	*Ringed Chirus*	a	a	a	a	a	a	a	a	a	a	a	a
Anoplopoma fimbria	Candle-fish	b						b	b	b	b	b	a
Ophiodon elongatus	Green Rock-fish	a	a	a	a	a	a	a	a	a	a	a	a
SCORPÆNIDÆ.													
Sebastodes paucispinis	*Small-scaled* Rock-fish					b		b	b			b	b
Sebastichthys nigrocinctus	*Black-banded* Rock-fish		b	b	b			b					b
Sebastichthys ruber	*Rough Red* Rock-fish	a	a	a	a	a	a	a	a	a	a	a	a
Sebastichthys nebulosus=fasciatus	*Clouded* Rock-fish	a	a	a	a	a		a	a	a	a	a	a
Sebastichthys rosaceus=oculatus	*Pink-spotted* Rock-fish		a	a	a	a	a	a	a	a	a	a	a
Sebastichthys melanops	*Black* Rock-fish	a	a	a	a	a	a	a	a	a	a	a	a
Sebastichthys flavidus	*Yellow* Rock-fish	a		a	a	a	a	a	a	a	a	a	a
Sebastichthys auriculatus	*Black-eared* Rock-fish	a	a	a	a	a	a	a	a	a	a	a	a
Sebasitchthys pinniger	*Smooth Red* Rock-fish	a	a	a	a	a	a	a	a	a	a	a	a
COTTIDÆ.													
Scorpænichthys marmoratus	Bull-head, *Marble Sculpin*			b	b	b	b	b		b		b	b
Hemilepidotus spinosus	*Rough-backed Sculpin*				b								
Leptocottus armatus	*Yellow* Sculpin							b			b		
Artedius pugettensis	*Big-headed Sculpin*					b		b		b			
SCIENIDÆ.													
Atractoscion nobilis	Sea Basse	a				a	a	a	a	a	a	a	a
Genyanemus lineatus	King-fish Little Basse	a	a	a	a	a	a	a	a	a	a	a	a

FISHES—Continued.

SCIENTIFIC NAME.	ENGLISH NAME.	1878.			1879.								
		October	November	December	January	February	March	April	May	June	July	August	September
Seriphus politus	*Large-mouthed King-fish*							b					b
EMBIOTOCIDÆ.													
Embiotoca jacksoni	Black Perch, Porgee	a	a	a	a	a	a	a	a	a	a	a	a
Embiotoca laterale	*Banded Perch*	a	a	a	a	a	a	a	a	a	a	a	a
Hypsurus caryi	*Orange-finned Perch*								a	a	a	a	a
Rhacochilus toxotes	*Thick-lipped Perch*							a	a	a	a	a	a
Phanerodon furcatus	*Small* Silver Perch								a	a	a		a
Damalichthys vacca	*Grey* Perch					a		a	a	a	a	a	a
Cymatogaster aggregatus	*Large* Shiner	a	a			a	a	a	a	a		a	
Hyperprosopon megalops=argenteus	Silver Perch, *Large-eyed Perch*	a		a		a	a	a	a	a	a	a	a
Hyperprosopon arcuatus								a	a	a	a	a	b
Hyperprosopon agassizii	*Agassiz's* Perch								b				
Holconotus rhodoterus	*Red-finned Silver* Perch	a	a	a	a	a	a	a	a	a			
Amphistichus argenteus	*Cross-banded Silver* Perch		a		a	a	a	a	a				a
SPHYRÆNIDÆ.													
Sphyræna argentea	Barracuda	a		a		a	a	a				a	a
SCOMBRIDÆ.													
Scomber colias	Spanish Mackerel							ab					b
Chriomitra concolor	*Monterey Tunny*	b	b							b			b
Sarda chilensis=lineolata	*Striped* Bonito	b	b					b			b	b	a
Poronotus simillimus	Pompino	a	a		a	a	a	a	a	a	a	a	a
Trachurus symmetricus	Horse-Mackerel	ab		ab				ab			ab		ab
BLENNIDÆ.													
Anarrhichthys felis	Wolf-eel, *Eyed Blenny*									b	b	b	b
Cebidichthys violaceus	*Crested Blenny*					b				b	b	b	
Apodichthys flavidus	*Green Blenny*	b										b	

BATRACHIDÆ.													
Porichthys porosissimus	Toad-fish								a	b			b
ATHERINIDÆ.													
Chirostoma californiensis	Smelt, *Large Mullet-smelt*	a	a	a	a	a	a	a	a	a	a	a	a
Atherinops affinis	Smelt, *Small Mullet-smelt*	a	a	a	a	a	a	a	a	a	a	a	a
MUGILIDÆ.													
Mugil sp. ?	Mullet	b						b					
GADIDÆ.													
Microgadus californicus	Tom-cod	a	a	a	a	a	a	a	a	a	a	a	a
Merlucius productus	Whiting					b	b	b	b		b	b	a
BROTULIDÆ.													
Brosmophycis marginatus	Cusk, *Red-fin*		b						b				
LYCODIDÆ.													
Leurynnis paucidens	*Cod-eel*						b	b	a	b	b	b	b
OPHIDIIDÆ.													
Ophidium taylori	*Sand-eel*							b	b				
PLEURONECTIDÆ.													
Hippoglossus vulgaris?	Halibut						b			ab		ab	
Paralichthys maculosus	Monterey Halibut, Bastard Halibut		b	b	b	b	b	a	a	a	a	a	b
Psettichthys melanostictus	Sole, *Black-dotted Flounder*	a	a	a	a	a	a	a	a	a	a	a	a
Hippoglossoides jordani	*Large-eyed Flounder*	a	a	a	a	a	a	a	a	a	a	a	a
Citharichthys sordidus	*Left-handed Flounder*	a	a	a	a	a	a	a	a	a	a	a	a
Glyptocephalus pacificus	*Short-finned Narrow Sole*						b	b	b	a	a	a	a
Glyptocephalus zachirus	*Long-finned Narrow Sole*						b	b	b	b	b		
Pleuronichthys guttulatus	Turbot	a	a	a	a	a	a	a	a	a	a	b	a
Pleuronichthys cœnosus	Bastard Turbot, *Cheek-finned Flounder*					b	b	b	b	b	b	b	b
Parophrys vetulus	*Diamond Flounder*	a	a	a	a	a	a	a	a	a	a	a	a
Lepidopsetta bilineata	*Mottled Flounder*	b				b	ab	ab	ab	ab	ab	b	
Lepidopsetta umbrosa	*Rough Flounder*					b	b	ab	ab	ab	ab	ab	ab
Platichthys stellatus	Flounder, *Striped-finned Flounder*	a	a	a	a	a	a	a	a	a	a	a	a
SALMONIDÆ.													
Oncorhynchus quinnat	Salmon	a	a	a	a	a	a	a	a	a	a	a	a
Salar tsuppitch	Black Trout of Lake Tahoe				a	a	a	a					
Salar henshawi	Silver Trout of Lake Tahoe	a	a	a					a	a			

FISHES—Continued.

SCIENTIFIC NAME.	ENGLISH NAME.	1878.			1879.								
		October	November	December	January	February	March	April	May	June	July	August	September
Osmerus thaleichthys	*Curve-mouthed* Silver Smelt	a	a		a	a	a	a	a	a	a	a	a
Osmerus elongatus	*Elongate* Silver Smelt	a	a		a	a	a	a	a		a	a	a
Hypomesus olidus	*Small-mouthed* Silver Smelt	a	a	a	a	a	a	a	a	a	a	a	
CLUPERIDÆ.													
Clupea sagax	Sardine	?					b	b	a	a	a	a	a
Clupea mirabilis	Herring	?	?	?	?	?	?	?	?				b
Engraulis ringens	Anchovy		a	a	a	a	a	a	a	a	a	a	a
Alosa sapidissima	Shad	b						b	b	b	b	b	
CYPRINIDÆ.													
Catostomus occidentalis	Western Sucker				a	a	a	a	a				b
Carassius vulgaris	German Carp			ab	ab	ab				ab			
Gila grandis	Pike, *Pike-headed Gila*		b		b	a	a	a	a	a	a		a
Pogonichthys inæquilobus	Split-tail						ab	ab	ab	ab			ab
Orthodon microlepidotus	*Small-scaled Orthodon*					ab	ab	ab		a		b	
Lavinia crassicauda	Thick-tail					b	b						b
SILURIDÆ.													
Amiurus albidus	Cat-fish				ab	ab	ab	ab	ab	ab		b	a
ACIPENSERIDÆ.													
Acipenser brachyrhynchus	Sturgeon, *Short-nosed* Sturgeon	a	a	a	a	a	a	a	a	a	a	a	a
ELASMOBRANCHII.													
Triacis semifasciatus	Tiger Shark						b						
Mustelus hinnulus=californicus	Dog-fish										b		
Rhinobatus productus	*Skate-shark*			b									
Squatina angelus	Monk-fish, Angel-fish				b								
Raia binoculata	Skate	a	a	a	a	a	a	a	a	a	a	a	a

NOTE.—*Clupea mirabilis.* The Herring season is at its hight in November.

RECEIPTS AND EXPENDITURES.

The following is an account of receipts and expenditures since our last report:

Receipts.

November 16, 1877—By cash on hand, last report	$3,563 13
February 19, 1878—By cash returned from Livingston Stone	30 61
November 29, 1878—By cash, warrant one-half of appropriation	2,500 00
February 25, 1879—By cash, warrant one-half of appropriation	2,500 00
August 16, 1879—By cash, warrant appropriation for this year	5,000 00
	$13,593 74

Expenditures.

November 26, 1877—To paid Wells, Fargo & Company, expressage on report	$0 50
November 30, 1877—To paid McKenna, expenses in making arrests	100 00
December 7, 1877—To paid telegrams to Sacramento	1 30
December 20, 1877—To paid postage and telegram	1 25
December 28, 1877—To paid Wells, Fargo & Company, expressage on trout, eggs, and telegram	51 10
December 31, 1877—To paid Woodbury, foreman at hatching-house, one month's salary	150 00
January 3, 1878—To paid purchase of spawning fish	2 30
January 8, 1878—To paid R. M. Davis, expenses in four arrests and convictions	200 00
January 10, 1878—To paid Jacob Underhill, hardware for hatching-house, and telegram	53 52
January 17, 1878—To paid Whitby, carpenter, expressage on L. L. salmon and white-fish eggs, etc.	156 95
January 21, 1878—To paid lumber for hatching-house, and Wells, Fargo & Co. on land-locked salmon eggs	179 50
January 28, 1878—To paid nails, paint, etc., and expressage on fish eggs	63 35
January 29, 1878—To paid Palmer & Son, 25,000 trout eggs; Stone & Hooper, 45,000 trout eggs	251 75
February 2, 1878—To paid Whitby, carpenter, on labor, hatching-house	100 00
February 4, 1878—To paid Fitzpatrick, labor, one month, to 1st	40 00
February 5, 1878—To paid Whitby, carpenter, balance	92 50
February 19, 1878—To paid L. Stone, balance hatching 2,200,000 salmon	500 00
February 19, 1878—To paid Woodbury, one month's salary	150 00
February 19, 1878—To paid wire cloth, flannel, and expressage	58 15
March 8, 1878—To paid expressage on trout to Santa Barbara, L. L. salmon, to Summit, etc.	22 50
March 8, 1878—To paid Underhill, hardware and furnishing hatching-house	160 07
March 18, 1878—To paid Wells, Fargo & Company, expressage on fish to sundry points, drayage of cans, etc.	43 10
March 18, 1878—To paid Woodbury, salary, one month	150 00
March 18, 1878—To paid Fitzpatrick, salary, one month	60 00
March 21, 1878—To paid Clark, work on hatching-house and expressage	41 10
March 21, 1878—To paid land-locked salmon to Donner Lake	12 50
March 26, 1878—To paid Whittier & Fuller, asphaltum and drayage of cans	5 80
April 3, 1878—To paid Woodbury, on account, $20; ice, $6 50	26 50
April 6, 1878—To paid expressage on land-locked salmon to Tulare Lake	20 00
April 6, 1878—To paid labor and expenses in distributing cat-fish	50 00
April 15, 1878—To paid Woodbury, salary	145 50
April 15, 1878—To paid Fitzpatrick, labor	60 00
April 15, 1878—To paid Stratton, Kirkham, and Wells, Fargo & Company, for transporting cans and fish	24 10
April 16, 1878—To paid telegrams and drayage	1 50
April 17, 1878—To paid expenses in transporting trout to Alder, Nevada, and Russian River	36 19
April 17, 1878—To paid Myron Green for 32,000 McCloud trout eggs	128 00
April 27, 1878—To paid bill of Taylor & Company, for lumber for hatching-house, troughs, etc.	76 39
May 6, 1878—To paid Fitzpatrick, in full, for labor to May 1st	30 00
May 6, 1878—To paid Woodbury, on account	20 00

May 11, 1878—To paid expressage on fish and cans, etc.	11 92
May 11, 1878—To paid Woodbury, services and sundry expenses in full	135 40
May 19, 1878—To paid Woodbury, expenses to Pit River and return	125 00
June 7, 1878—To paid Woodbury, balance expenses and telegram	11 00
June 18, 1878—To paid ice for shad, freight, and expressage, etc	8 40
August 13, 1878—To paid purchase and distribution 12,700 cat-fish in seven counties	129 75
August 14, 1878—To paid ice and expressage of fish	16 20
August 19, 1878—To paid Mr. Glashan, expenses Truckee and Tahoe	46 85
September 18, 1878—To paid Pither, procuring and distribution 5,200 cat-fish in five counties	104 00
October 1, 1878—To paid telegrams and cat-fish for San Joaquin	15 40
October 26, 1878—To paid Pither, catfish for exchange to Honolulu	13 75
November 4, 1878—To paid Woodbury, on account $50 copying notices, telegrams, etc.	66 25
December 6, 1878—To paid Stone, hatching 500,000 salmon, telegrams, etc.	262 00
December 11, 1878—To paid Cowdery & Preston, case of Ashton vs. McLean	20 00
December 27, 1878—To paid freight and express, white-fish eggs from Michigan	24 15
January 3, 1879—To paid freight and express, white-fish eggs from Michigan	112 40
January 3, 1879—To paid Stone & Hooper, and Myron Green, trout eggs	167 20
January 3, 1879—To paid Woodbury, balance salary, flannel, and stationery	120 00
January 6, 1879—To paid wire cloth, and transporting white-fish to Tahoe	31 15
January 15, 1879—To paid L. Stone, on account purchase 2,500,000 salmon eggs	500 00
January 18, 1879—To paid expense white-fish to Reno and Tahoe	20 00
February 3, 1879—To paid Woodbury, salary for January, $150, express, $16 50	166 50
February 5, 1879—To paid Richardson, one month's labor, $100; expenses on white-fish to Tulare, $35 30	135 30
February 10, 1879—To paid Palmer & Sons, 25,000 trout eggs	63 00
February 27, 1879—To paid expenses distributing trout	30 25
March 2, 1879—To paid Richardson, one month's labor	100 00
March 6, 1879—To paid Woodbury, one month's salary, $150 00, expenses, etc.	165 75
March 6, 1879—To paid L. Stone, balance due for 2,500,000 salmon	600 00
March 20, 1879—To paid Pither, 2,000 cat-fish, Yolo, $42 50; Sheriff's fees, Sonoma, $6 70	49 20
March 20, 1879—To paid expenses examining dams on Tuolumne, wire-cloth, and telegrams	13 25
March 29, 1879—To paid Woodbury, salary one month, $150 00; distributing trout, expenses, etc.	173 50
April 8, 1879—To paid distributing trout in San Mateo and Santa Cruz, etc.	34 85
April 14, 1879—To paid Richardson, one and one-half month's labor, $150 00; Woodbury, one-half month, $75 00	225 00
April 14, 1879—To paid express on fish and cans	15 95
April 14, 1879—To paid Myron Green for 50,000 trout eggs	200 00
April 19, 1879—To paid Jones, transporting trout, American River	10 00
April 23, 1879—To paid for ice in transporting fish, $21 50; tin strainer, $3 00	24 50
May 8, 1879—To paid Stone, on account for transporting lobsters, etc., $500 00; exchange, $1 50	501 50
May 22, 1879—To paid telegram, $2 00; draft of L. Stone, account for transporting lobsters, eels, etc.	805 10
June 2, 1879—To paid Pither for distributing 3,500 cat-fish in five counties	88 75
June 13, 1879—To paid cash for salt-water, telegram, and transporting fish to Lake County	18 00
June 19, 1879—To paid for transporting black bass to Crystal Springs Lake, $1 50; L. Stone, balance, $200 00	201 50
June 24, 1879—To paid W. N. Lockington, for services and report on marine fishes	100 00
June 27, 1879—To paid for repair of wagon broken in transporting fish	7 50
August 14, 1879—To paid Pither, for distributing 2,500 cat-fish in three counties, barrels, etc.	65 10
August 18, 1879—To paid steamer Neptune for transporting lobsters	100 00
August 26, 1879—To paid H. D. Dunn for four days' services at Collinsville	28 25
September 1, 1879—To paid for distributing 3,700 cat-fish to Pit River, Truckee, Los Angeles, and Lassen Counties	113 95
September 8, 1879—To paid Lansing, for gathering statistics, $50 00; express, $10 40; ice, $10 00	70 40
September 16, 1879—To paid J. C. Frazer, 50,000 trout for Truckee, South Yuba, and American Rivers	254 30
September 23, 1879—To paid H. C. Marks on account copying report	40 00
September 28, 1879—To paid distributing 3,500 catfish, Mendocino, Solano, Nevada, Lassen, and Mono Counties	112 40
November 1, 1879—To amount on hand to balance	3,873 70
Total	$13,593 74

This balance of $3,873 70 remaining on hand will be expended in payment for the 2,500,000 salmon eggs now hatching on McCloud River, and in the distribution of the young fish in that stream, the Pit, and Sacramento, as well as in the necessary expenses to be incurred in hatching white-fish and other eggs donated by the United States Government.

All of which is respectfully submitted.

B. B. REDDING,
S. K. THROCKMORTON,
J. D. FARWELL,
Commissioners of Fisheries.

SAN FRANCISCO, November 1st, 1879.

LIST OF FISH COMMISSIONERS.

UNITED STATES.

Prof. Spencer F. Baird	Washington, D. C.

ALABAMA.

Charles S. G. Doster	Prattville.

ARKANSAS.

N. B. Pearce	Osage Mills.

CALIFORNIA.

S. R. Throckmorton	San Francisco.
B. B. Redding	San Francisco.
J. D. Farwell	Alameda.

COLORADO.

W. E. Sisty	Brookvale.

CONNECTICUT.

W. M. Hudson	Hartford.
Robert G. Pike	Middletown.
James A. Bill	Lynne.

GEORGIA.

Thomas P. James	Atlanta.

ILLINOIS.

N. K. Fairbank	Chicago.
S. P. Bartlett	Quincy.
J. Smith Briggs	Kankakee.

IOWA.

B. F. Shaw	Anamosa.

KANSAS.

D. B. Long	Ellsworth.

KENTUCKY.

William Griffith, President, 166 West Main St.,	Louisville.
John B. Walker	Madisonville.
Hon. C. J. Walton	Munfordville.
Hon. John A. Steele	Versailles.
Hon. J. H. Bruce	Lancaster.
P. H. Darby	Princeton.
Dr. S. W. Coombs	Bowling Green.
Hon. James B. Casey	Covington.
General T. T. Garrard	Manchester.
Hon. W. C. Allen	Owingsville.

MAINE.

E. M. Stilwell	Bangor.
Everett Smith	Portland.

MARYLAND.

T. B. Ferguson, 1327 M St.,	Washington, D. C.
Thomas Hughlett	Easton.

MASSACHUSETTS.

Theodore Lyman	Brookline.
E. A. Brackett	Winchester.
Asa French	Boston.

MICHIGAN.

Eli R. Miller	Richland.
A. J. Kellogg	Detroit.
Dr. J. C. Parker	Grand Rapids.

MINNESOTA.

1st District, Daniel Cameron	La Crosse.
2d District, Wm. W. Sweney, M.D.	Red Wing.
3d District, Ormsby Sweeny	St. Paul.

MISSOURI.

I. G. W. Steedman	2803 Pine Street, St. Louis.
John Reid	Lexington.
Silas Woodson	St. Joseph.

NEVADA.

H. G. Parker	Carson City.

NEW HAMPSHIRE.

Samuel Webber	Manchester.
Luther Hayes	South Milton.
Albina H. Powers	Plymouth.

NEW JERSEY.

Dr. B. P. Howell	Woodbury.
Colonel E. J. Anderson	Trenton.
Theodore Morford	Newton.

NEW YORK.

R. Barnwell Roosevelt	76 Chamber St., N. Y.
Edward M. Smith	Rochester.
Richard U. Sherman	New Hartford.
Eugene G. Blackford, 809 Bedford Av.,	Brooklyn.

NORTH CAROLINA.

L. L. Polk	Raleigh.
S. G. Worth	Morgantown.

NEBRASKA.

R. R. Livingston	Plattsmouth.
H. S. Kaley	Red Cloud.
W. L. May	Freemont.

OHIO.

J. C. Fisher	Coshocton.
R. Cummings	Toledo.
L. A. Harris	Cincinnati.

PENNSYLVANIA.

H. J. Reeder	Easton.
Benj. L. Hewitt	Hollidaysburg.
James Duffy	Marietta.
John Hummel	Selinsgrove.
Robert Dalzell	Pittsburg.
G. M. Miller	Wilkesbarre.

RHODE ISLAND.

Alfred A. Reid	Providence.
John H. Barden	Rockland.
Newton Dexter	Providence.

SOUTH CAROLINA.

A. P. Butler	Hamburg.

TENNESSEE.

W. W. McDowell	Memphis.
Geo. F. Akers	Nashville.
W. T. Turley	Knoxville.

UTAH.

A. P. Rockwood	Salt Lake City.

VERMONT.

M. Goldsmith	Rutland.
Charles Barrett	Grafton.

VIRGINIA.

Colonel Marshall McDonald	Lexington.

WEST VIRGINIA.

Henry B. Miller	Wheeling.
Christian S. White	Romney.
N. M. Lowry	Hinton.

WISCONSIN.

Governor William E. Smith	Madison.
Philo Dunning	Madison.
J. V. Jones	Oshkosh.
C. L. Valentine	Janesville.
Mark Douglas	Melrose.
John F. Antisdel	Milwaukee.
Christopher Hutchinson	Beetown.
H. W. Welsher	Madison.

REPORT

OF THE

COMMISSIONERS OF FISHERIES

OF THE

STATE OF CALIFORNIA,

FOR THE

Year 1880.

AUG 1 1935

Fish & Game Commission
Library Copy
SAN FRANCISCO, CALIF.

REPORT.

To his Excellency George C. Perkins, *Governor of California:*

The Commissioners of Fisheries for the State of California, appointed under an Act of the Legislature entitled "An Act to provide for the restoration and preservation of fish in the waters of this State," approved April 2, 1870, respectfully submit their sixth report.

Heretofore reports of the transactions of the Fish Commissioners have been made biennially, at the meeting of each Legislature. The change in time for submitting a statement of our operations, required by the adoption of the new Constitution, necessarily limits this report to the proceedings of the past year.

SACRAMENTO SALMON—ONCORHYNCHUS QUINNAT.

It is with pleasure we report that the annual hatching of two millions of these fish, and placing them in the tributaries of the Sacramento River, are producing their legitimate results. The numbers of salmon that could have been taken in this river, before the greater part of their spawning beds had been destroyed by sediment from the gold mines, can never be known. It is the testimony of all the pioneer miners that every tributary of the Sacramento, at the commencement of mining, was, in the season, filled with this fish, hurrying and struggling as if to reach the very sources of these streams. A few salmon continued to enter the Feather, Yuba, Bear, and American Rivers until the floods of the Winter of 1860–1, which covered the gravel bottoms of all those streams with mining sediment, and thereby destroyed their spawning grounds. Continuous and unrestricted fishing, and the destruction by mining of so large an area of clean beds of gravel, reduced this fish in numbers in the Sacramento until, in the season of 1872 and 1873, there were probably less than at any other time before or since. Several thousands of young fish, artificially hatched, were placed in the head waters by the United States prior to 1873. In that year we made arrangements with the United States authorities to hatch our quota of the eggs annually given to each State, at an expense of $1,000 for each million of fish hatched out and turned into the river. Including 2,225,000 fish just placed in the head waters, there have been hatched by the State, and turned into the McCloud, Pit, and Upper Sacramento Rivers, 15,350,000 young salmon.

It seemed desirable that a record should be kept of the catch of salmon in the Sacramento, so as to learn the effect on this industry of the annual deposit of these two million young salmon.

Since 1874 we have obtained the numbers and weight of salmon caught in the Sacramento and San Joaquin, that have been transported from the place of capture, to the Cities of San Francisco, Sacramento and Stockton, by rail and steamboats, as also the numbers and weight of salmon put up in tins by the different canning establishments. We have been unable to obtain the weight of salmon salted, and the numbers and weight of salmon caught near the mouth of Feather River, and by the fishermen near Tehama, and in the upper waters of the Sacramento and San Joaquin. Neither can we obtain the numbers and weight of those taken to market by fishermen in their own boats, nor those caught and salted, in violation of law, during the close season. Therefore, to the weight of salmon actually taken to market by rail and steamboats, and the salmon actually tinned, we have added twenty-five per cent., the total being a close approximation of the actual catch for the season.

This system has been pursued since we commenced in 1873, to gather the statistics of the catch of salmon in the Sacramento River. The record is as follows:

For season ending August 1, 1875	5,098,781 pounds.
For season ending August 1, 1876	5,311,423 pounds.
For season ending August 1, 1877	6,493,563 pounds.
For season ending August 1, 1878	6,520,768 pounds.
Eor season ending August 1, 1879	4,432,250 pounds.
For season ending August 1, 1880	10,837,400 pounds.

In the season, ending August 1, 1879, the salmon were reported to be as numerous as ever before known, but for three weeks, during the height of the season, in consequence of a disagreement between the fishermen and the proprietors of canning establishments, no salmon were taken, except for daily consumption in the city markets. It will be seen that the catch of 1880 was the largest ever reported, and that the weight of salmon captured has doubled since the State's appropriation enabled us to place annually an average of two million young fish in the head waters of the Sacramento. The fishermen, as well as the proprietors of canning establishments, are beginning to acknowledge that the annual addition of two million young fish to the river, over and above those naturally hatched, does, after two or three years, add to the numbers of mature fish to be found in the river.

More young fish have been taken by the fishermen, during the past two years, than ever before; and more young fish have appeared on the spawning beds of the McCloud, during the same period, than have heretofore been observed.

The increase in the numbers and weight of fish taken, and the immense numbers of young fish that reach the spawning grounds from the ocean, are conclusive evidence that the expenditure, by the State, of money, in the artificial hatching of salmon, is a most profitable investment for the public benefit. The increase of fish, by artificial propagation, has doubled the annual catch of salmon in the river, correspondingly added to the numbers of men and boats engaged in the industry, and warranted the investment of not less than $300,000 in the erection and equipment of salmon canning establishments.

When the State commenced the work of artificially hatching salmon, and placing the young fish into the head waters of the rivers, there were no canning establishments on the Sacramento River. Now, on the river, and in the cities, there are nine. The State appropriation for fish hatching may be said to have created this industry. To show with what rapidity this business is growing, it may be stated that in 1879 there were tinned, of Sacramento River salmon, 33,017 cases of forty-eight pounds each, or 1,584,816 pounds. In 1880 there were tinned 62,000 cases of forty-eight pounds each, or 2,976,000 pounds.

The average catch of salmon in the rivers, before the State added to the numbers by artificial hatching, was five million pounds. This, to persons not controlled by narrow personal interest or cupidity, would be convincing evidence of the wisdom of the State laws for the promotion and increase of this industry. Yet, strange as it may seem, it is the history of the fish industry of every State in the Union, and of all other countries, that when public moneys are used to add to the numbers of fish to be caught, not only the fishermen, but the owners of large capital invested in the business, are unremitting and persistent in their applications for the repeal of all laws that place any restriction upon unlimited fishing. The perpetuation of the salmon industry is absolutely dependent upon the fact that some of the fish must be allowed to pass the nets and reach their spawning grounds at the head waters. It is only at the sources of streams, and under the conditions there found, that the eggs will naturally develop into fish. It is only when the fish reach their spawning grounds that their eggs have become sufficiently matured so that they may be taken for artificial propagation. These facts are well known and undisputed, yet the Legislature is biennially besieged to repeal the law, or to so change it that practically there shall be no limit to fishing while there is a fish to be found in the river.

From the report of Mr. H. D. Dunn, who, in gathering statistics of the weight of salmon tinned from the Sacramento, may be learned the views of the gentlemen engaged in the salmon canning business. It will be seen that they also, with the fishermen, practically ask a repeal of the law which now allows some of the fish to reach their spawning grounds. They claim that if all nets were removed from the river from Saturday noon until Monday morning of each week, this would allow a sufficient number of fish to pass. They also assert that the present law (except by the canneries) is violated. They, however, neglect to state that if the close season were changed to suit their views, and increase the profits of their business, they would hardly stop to inquire, on Monday morning, whether the fish brought to them were caught on that morning or on Sunday.

Many changes have been made by succeeding Legislatures in the time for a close season for salmon. Every concession is taken as a basis for further changes, looking to the present profits of the fishermen and canners. Neither the fish, the public, nor the future of the business appears to have many friends. Any restrictions upon unlimited fishing and unlimited canning, while a fish can be found in the river, is looked upon as a personal injury, inflicted by a meddlesome and tyrannical government.

Under the present law the fish have so increased that the annual catch has more than doubled. Although the law is violated by many fishermen, yet the canning proprietors have so much capital invested that they fear to violate the law by canning fish out of season. Their obedience compels a partial observance of the law on the part of the fishermen. When the canneries cease work, as required by the present law, fish are usually quite numerous in the river. During the close season no salmon are sold in the city markets, the canneries dare not purchase, and the greater number of fishermen cease work. A few, determined to oppose any law, still continue to draw their nets, and salt the catch in by-places among the tule islands. At this season the fish are gravid and unfit for food, and whenever canned or salted in this condition and sold, they injure the character, in the markets of the world, of all the fish shipped from the river where such fish are attempted to be utilized. On the Columbia River, without any requirement of law, the canners cease work on the first of August, not because there are not fish still to be taken, but because they are over ripe. They have found that the tinning of over ripe fish injures the reputation and lowers the standard of the whole season's work. The standing of the tinned salmon of the Sacramento would have been as high, in foreign markets, as that of the rivers of Oregon had not the greed of a prominent canning firm induced them, at the commencement of their business, to tin over ripe fish.

We desire to add that the present law for a close season may lessen immediate profits, but it perpetuates the business, leaves fish for those who will succeed us, compels a high standard for Sacramento salmon, makes this fish almost the cheapest food in the State, and is for the best interest of the public, who are taxed to keep up and increase the numbers of fish in the rivers.

The report of Mr. H. D. Dunn, which follows, in addition to the statistical information which it contains, also gives fully the views of the proprietors of the canning establishments, which, as heretofore, will be urgently pressed upon the attention of the Legislature. In reply to these requests so plausibly stated, we have to repeat, if salmon are to be continued in our rivers, a large number of the fish must be allowed to reach their spawning grounds, not accidently or by chance, but systematically, and by design. The fishermen will not cease fishing Sundays while there are canners to buy all that may be brought Monday morning. Therefore, as at present, the canneries should cease work during a few weeks of the time after the fish have come in from the ocean, and are on their urgent errand to their spawning beds.

SAN FRANCISCO, CALIFORNIA, December 21, 1880.

To Board of California State Fish Commissioners, San Francisco, California:

GENTLEMEN: From inquiries made of parties engaged in the business, I learn that there has been packed at the canneries on the Sacramento River and in this city about 62,000 cases of salmon, of four dozen one-pound tins each. All these salmon were taken from the waters of Suisun Bay and the Sacramento and San Joaquin Rivers. These salmon averaged about twelve pounds each when taken.

There were also packed in Smith's River, in this State, during the present year, 7,500 cases salmon of four dozen one-pound tins each, and five hundred barrels salted down.

There were also packed in Eel River, in this State, about 6,250 cases salmon of four dozen one-pound tins each, and as far as can be estimated, about 1,500 barrels salted down. The salmon in both these rivers are reported to have averaged about ten pounds weight each when taken.

A new feature this year was the engaging in the business in this city of four fruit canning establishments, viz.: Chas. King, of Wm. & Co., A. Lusk & Co., Emerson, Corville & Co., and the Cutting Packing Company. A portion of the fish canned by these firms was purchased at the wharves in this city, and the others of fishermen on the Sacramento River.

During the open season, the run of salmon in the Sacramento River was very large, being in excess of any previous year known. The supply taken by the fishermen at times being in excess of the wants of the canneries, the surplus fish were brought to San Francisco for sale, many spoiling and being thrown into the bay.

After the expiration of the close season (September 15th), the run of salmon was extremely large, but lasted for about ten days only, during which, on the 15th, 16th, and 17th of September, it was estimated that fully nine thousand fish were thrown back into the river, thus wasted, for want of purchasers.

An unusual circumstance, this season, connected with fishing on the Sacramento River, has been a large run of salmon during the present month (December), boats averaging from forty to fifty fish per day, when from five to ten were the catch in prior years. As the canneries are all closed, and an abundant supply salted for the present year, a very large number of these salmon will probably reach their spawning grounds, at the head waters of the Sacramento River.

During the close season, between August 1, and September 15, the law was openly violated by the fishermen, who defied arrest and conviction for the offenses. The few persons who were arrested were taken to Suisun City, Solano County, where no conviction could be had, it being stated that public opinion there was adverse to the law. That the close season was openly and persistently violated by the fishermen on the Sacramento and San Joaquin Rivers was a matter of notoriety, and parties, well informed, stated that the number of salmon taken, in violation of law, and salted and smoked, was in excess of those supplied to the canneries and city markets, during the legal season. As an illustration of the large number thus taken, a person of credibility, engaged in the canning business, stated to me that he knew of two fishermen (owning one boat between them) selling, since the close season expired, two hundred barrels salted salmon, which is equal to four thousand salmon, or more than the united catch of three average boats before August 1.

Another party informed me that salmon were taken frequently in sight of Collinsville on the Sacramento River, and also in the San Joaquin River, during the close season, in daylight, without any attempt at concealment. The same person stated that he saw lying on the wharf at mid-day, during the close season, at Webb's Landing, on the San Joaquin River, from five hundred to six hundred salmon, the fishermen cleaning and salting the same, regardless of who might see them.

Though the price of salmon ruled low (from one dollar and five cents to one dollar and ten cents per dozen) all the canneries in this State, except one at Black Diamond Landing, Contra Costa County, were actively employed during the past season. The canneries were as follows: One each, Washington, Courtland, Chipp's Island, Smith's River, and Eel River; two at Collinsville, and four in San Francisco—eleven in all employed. From what I can learn, a similar number will probably be employed during the coming season, action having already been taken for that purpose. A canning factory at Benicia, during 1881, is also among the probabilities. Unforeseen adverse circumstances excepted, it seems probable that more salmon will be canned in this State during 1881 than in any previous year, as should the catch justify it, other canneries in this city may engage in the trade. The city canneries have greater advantages, they employing skilled labor continuously during the larger portion of the year, while the time of the canneries on the rivers is not only limited, but is broken by the close season, after which it is difficult to engage workmen for so few days work as the run of fish may last.

As all information connected with the taking of salmon is of interest to the Commissioners, I deem it right to advise you of the feeling of canners with whom I have conversed, regarding the present law of this State. These parties complain that the six weeks' close season in the height of the run of salmon puts them to large additional expense, as compared with the canners on the Columbia, and other salmon rivers north; that at present, on the Sacramento and San Joaquin Rivers, the canneries have a supply of salmon for about six weeks only, as during the greater part of June and July the run is very uncertain; during which, they have to be at the same expense as if there was full work for their employés; that nothing is saved to the State by the close season, as salmon are taken in large quantities by the fishermen, in defiance of the law; that the fishermen, after having gone to the expense and labor of salting the salmon so taken, receive a less price for them than what would be paid them if it were lawful to sell them to the canneries; that while the canneries pay thirty-five cents for the fish delivered to them, the fishermen sell their salted salmon, delivered in this city, at from fifteen to twenty-five cents each; that allowing for salt, labor, and freight, the salted salmon net the fishermen from ten to fifteen cents, instead of thirty-five cents paid at the canneries.

The canners claim that while the present law against taking salmon in the close season is a dead letter, from inability to enforce it, that modifications can be made for their benefit without injury to the best interests of the State. Their desire is to have the close season for taking salmon limited to thirty-six hours each week, extending from Saturday noon to Monday morning, claiming that this time being observed, sufficient spawning fish will reach the head waters of the Sacramento River to furnish all the eggs required to keep up the supply. They ask that this may be done, pledging themselves to aid in enforcing the law, which they will be able to do by refusing to take any fish taken during the close time; that if this change is made, and the result is not satisfactory, after trial, to the Commissioners, they, the canners, will not oppose a reënactment of the present law, if the former desire it. To aid in keeping up the supply of salmon, the canners propose to have all the boats taking salmon licensed, and if need be the canners also; that the sum so collected be paid to the Fish Commission as a fund to be expended in hatching out salmon to keep up the supply; that the boats being licensed will keep out poachers, who will be easily detected if the licensed boats are properly marked with large figures to insure identification; that at the present time all fishing boats being of the same model, and painted of the same color, it is practically impossible to identify them, and they can be and are loaned to other parties who violate the law without liability to confiscation.

I have taken the liberty of writing thus fully the views of the canners, so that the Commissioners may be advised of the same before the meeting of the State Legislature, next month.

Also, that if it should be desirable to have the canners explain their views more in detail, the Commissioners could meet them for that purpose and thereby be able to devise, if possible, some united action by which the fishing interests of the State would be increased.

I am, yours truly,

HORACE D. DUNN.

The following statement shows the numbers of salmon transported by rail and steamers from the fishing grounds of the Sacramento and San Joaquin to the Cities of San Francisco, Sacramento, and Stockton, from September 15, 1879, to August 1, 1880. It is to be regretted that some of the transporting companies do not keep the numbers and weight of sturgeon separate from those of the salmon. It is, however, thought that the numbers and weight of sturgeon were not in excess of previous years. It is also to be regretted that in one instance the numbers of salmon had to be approximated, in consequence of carelessness in making the necessary entries:

SUMMARY.

Shipments per steamer Enterprise	40,829
Shipments per steamer Julia	24,661
Shipments per steamer Chin-du-Wan	2,276
Shipments per steamer Modoc	1,729
Shipments per California Transportation Company	70,354
Shipments per Stockton line (estimated)	34,547
Shipments per rail to Oakland	13,750
Shipments per rail to San Francisco	150
Total numbers	188,296

While gathering the statistics of the cases of Sacramento salmon canned during the past year, Mr. Dunn procured the following statistics of salmon canned in Oregon, etc., the present season, which is also of interest:

On the Columbia River, 512,000 cases	4 dozen 1-pound tins each.
On the Fraser River, 40,000 cases	4 dozen 1-pound tins each.
On the Skeena, and other rivers, 21,000 cases	4 dozen 1-pound tins each.

Besides the foregoing, there were canneries in operation at Sinslaw and Rogue Rivers, Oregon; Puget Sound, Washington Territory; Prince of Wales Island, and Sitka, Alaska Territory, the catch of which he has been unable to obtain.

Under wise laws and small appropriations the salmon industry of California has doubled in five years. With a more faithful observance of the present laws, it can be doubled again in another five years. It would seem to be wise policy for the Legislature to disregard the appeals of even good citizens, whose judgments are liable to be wrested by their present personal profits. The Fish Commissioners stand between the general good of the public and private interests, and look to the Legislature, as representing the intelligence of the whole community, to sustain them in their efforts to foster, advance, and increase a great industry.

SHAD—ALOSA SAPIDISSIMA.

On the 18th of June, 1880, we received from the United States Fish Commissioner, a donation of 240,000 young shad, which arrived without loss, and were placed in the Sacramento River at Tehama. This makes in all 640,000 of these fish that have been placed in this river, through donations from the United States Fish Commissioner, and through importations by the State. These fish are now increasing by natural propagation, as fish of all ages are caught in the river, and in the salt water of the Bay of Monterey. A few years since, when mature shad first made their appearance, they sold for $1 50 per pound. They now sell for twenty and twenty-five cents per pound. They are as regularly quoted in the market reports as any other fish common to the waters of this State. Relatively to the numbers in our waters, more shad are caught in California than on the Atlantic Coast.

When the shad, after spawning, leave the eastern rivers they disappear and rarely, if ever, are taken in the ocean. Practically, they are only caught for market after entering the rivers. The shad turned into the Sacramento, when the time comes for them to leave the river, resort in large numbers to the Bay of Monterey, about one hundred miles south of San Francisco, where they find an abundance of food and remain until the procreative instinct compels them again to enter the river. Shad are caught at all seasons in the Bay of Monterey, in the nets of the fishermen while fishing for other fish. There is, therefore, no week during the year when shad cannot be found on the stalls in the San Francisco market. Looking to the natural increase of the fish, this is unfortunate, as it will require largely increased importations to fully stock our waters. When our rivers are fully stocked, now that the habits of this fish on our coast are known, there will be no difficulty in procuring this valuable fish at all seasons of the year.

Professor Baird, of the United States Fish Commission, is having constructed a railway car, to be solely used in the transporting of fish. When completed, he proposes to send in it two or three million young shad, which he believes will fully stock the Sacramento and San Joaquin Rivers, and eventually all the appropriate waters of this coast. We are entirely satisfied with the result of the experiments thus far made in importing and planting shad in the waters of California.

WHITE FISH—COREGONUS ALBA.

The 565,000 white fish, the eggs of which were brought from Lake Michigan, and planted in different lakes and streams of this State, appear to be thriving and increasing. We hear of them being occasionally taken. As they can only be successfully caught in nets made for the purpose, and rarely are taken with the hook, the probabilities are they will become very numerous before the fishermen will make a business of their capture. They are so valuable and highly esteemed fresh water fish that we shall make every effort to fully stock all our accessible mountain lakes. We have asked the United States Commissioner of Fisheries for a consignment of 250,000 of the eggs of this fish, to be hatched at the State's hatching house at San Leandro, for distribution during the present Winter.

SCHUYLKILL CATFISH—AMIURUS ALBIDUS.

The seventy-four catfish imported from the Raritan River, in 1874, have increased and multiplied, and this increase distributed, until now, we believe, there is no county in the State, from Del Norte to

San Diego, that has not been supplied with a greater or less number of these fish. They are regularly sold in all the markets, at the same prices as our most abundant fish. They are admirably adapted to the sloughs and warm waters of the great valley, and in them have so multiplied as to furnish a large supply of food. The aggregate value of this fish alone, sold in the markets of San Francisco and Sacramento annually, would more than equal the appropriation annually made by the State for fish culture. How constant has been the demand made upon us for the wide distribution of this fish, may be seen in our report of expenditures, which shows quite a large amount paid for their capture, and in sending them by express to different parts of the State. These fish are now so numerous and widely distributed that probably the time has arrived when their further distribution should be left to private enterprise, and the money of the State heretofore used for this purpose be employed in importing some other equally valuable fish.

CARP—CYPRINUS CARPIO COMMUNIS.

Since the date of our last report, we received from Professor Baird, at the Government carp ponds, in Washington, three hundred young carp of the most valuable variety. They were brought to California with the loss of but two. Sixty were placed in a public lake near Sacramento; the remainder were placed in the private pond of R. R. Thompson, in Alameda, who promised to protect them, and allow the State to remove them and their increase whenever desired. We have no report of those placed in Sutterville Lake; probably none of them have been caught. Those placed in the private pond at Alameda are doing well. These fish were hatched from the egg in June, 1879. When they arrived in this State, December 29, 1879, they averaged about two inches in length. In June, 1880, one year from the time they had left the egg, they had grown to a length of more than eight inches. During the latter month, at the request of Professor Baird, United States Fish Commissioner, we caused the pond to be netted, and of the carp taken, forwarded one dozen to the ponds at Mare Island, the Navy Department having expressed a desire that the ponds at this Navy Yard should be stocked with the most valuable variety of carp. The great increase in the size of the fish, and their fine appearance, make it certain they have found congenial homes. They were probably too young to have spawned last year. They will, without doubt, produce young fish during the Summer of 1881. When the young fish are ready for distribution, we shall take measures to distribute them to all the appropriate waters throughout the State.

The eight carp, of another variety, brought to this State in 1872, from Hamburg, by the late Mr. A. J. Poppe of Sonoma County, increased largely, and have been widely distributed. Wherever planted in our waters they have grown rapidly, and multiplied in numbers. No other variety of fish have so long been under the care and protection of man, and no other seems so capable of domestication. There appears to be a wide spread desire among farmers of this State, who have small natural or artificial ponds or sloughs on their land, to procure carp for stocking their waters. Although the carp belonging to the State have not yet produced any increase, and as it is not probable any of the young of this fish can be ready for distribution before the Winter of 1881, yet we have already on file twenty-three applications for the young of this fish from farmers in seventeen different counties. The carp will certainly thrive in all the interior waters of the State, with the possible exception of the lakes near the summit of the Sierra Nevada, where the water in Summer may be too cold. The carp furnishes so large a supply of food to the people of Europe and Asia, and promises to be of so much value to the people of this State, that we condense from the report of Mr. Rudolph Hessel to Professor Baird, the following information of the habits and natural history, etc., of this fish. He says: The carp is partial to stagnant waters, or such as have not a too swift current, with a loamy, muddy bottom, and deep places covered with vegetation. It is able to live in water where other fishes could not possibly exist—for instance, in the pools of bog meadows and sloughs. It lives upon vegetable food, as well as upon worms and larva of aquatic insects, which it turns up from the mud with the head; it is very easily satisfied, and will not refuse the offal of the kitchen, slaughter-houses, and breweries, or even the excrement of cattle and sheep.

In central Europe, where the water of the carp ponds becomes very cold, the fish will, at the beginning of the cold season, seek deeper water, making holes in the mud, where they pass the Winter in a kind of sleep. They make a cavity in the muddy ground, called a "kettle." In this they pass the time until Spring, huddled together in concentric circles, with their heads together, the posterior part of the body raised, and held immovably, scarcely lifting the gills for the process of breathing, and without taking a particle of food. It is a most striking fact that the carp, though it does not take any food, during this Winter sleep, yet does not diminish in weight. In the warm climates of Southern Europe, Italy, Spain, Dalmatia, etc., the fish become lively at a much earlier season in the Spring, and Mr. Hessel doubts if, in these climates, it ever goes into a lethargic state, or ceases to feed during the Winter. When the Spring is early, or the water has become warmed by the sun, in central Europe, it is ready to spawn by May, and continues spawning at intervals for a month or two. Days and weeks may pass before it will have left the last egg to the care of nature. In Sicily, and in Algeria, which have climates not dissimilar to the interior of California, it commences to spawn in April. The female carp yields an immense number of eggs. One of five pounds weight has produced half a million. The eggs are adhesive, and are, when extruded, attached to aquatic plants, brush, or stones. The male fish follows the female among the growing water grass and weeds, and impregnates the eggs after they are extruded. If the weather is warm, the young fish are hatched in about two weeks. Cold water delays the hatching of the eggs for about three weeks. Ponds of cold water with a rock bottom are not favorable to the growth of this fish. If the water is warm, and the pond has a muddy bottom, the young fish should, at the close of the third Summer, weigh an average of three pounds. If the pond contain large quantities of food, the fish may weigh as much as five pounds at the close of the third year. This fish is said to live to a great age, and is also said to increase in weight up to about thirty years. Ponds for carp, in California, need not be over three feet in depth.

In stocking ponds, in Europe, it is estimated that there should be placed in the water three mature females and two males to each acre. The eggs are subject to many casualties; they get smothered, are eaten by other fish, and even by the parents, so that it is not usual to obtain more than eight hundred or one thousand young fish from the vast number of eggs extruded by each female. A larger percentage of young fish would be obtained if the pond contained no fish but carp, and the parents were caught and removed to other waters after the eggs were deposited. The eggs of carp, although adhesive, have been hatched artificially. A more simple plan is to make a rough box-shaped frame of willow sticks, tied or nailed together, four or five feet long, three wide, and one high. This frame should be densely interwoven with the brush of Monterey cypress, or of the redwood, and not to be trimmed on the inside of the frame. Put this in the pond where it can float, and place in it two ripe females and one male; cover the top with netting, so that the fish may not escape. The females will fill the brush on the bottom and sides with eggs, which the male will impregnate. When the spawning is completed, the fish should be removed. In due time the young fish will make their appearance. This is a close imitation of nature, while the eggs are preserved from enemies.

The carp in Europe is considered so valuable a fish, and supplies such a large amount of food, that it is deservedly popular. Wherever it has been introduced in California, it has grown and increased in numbers.

So many persons are desirous of obtaining this fish for ponds, sloughs, and lakes, in their several localities that we have considered it advisable to give this condensed statement as to the best means for the care and increase of this variety of fish.

BLACK BASS—MICROPTERUS NIGRICANS.

The seventy-three black bass placed in Napa River in 1873, were probably all caught by anglers before they had time to propagate. We heard that some were caught, during that year, from the river in which they were deposited, but cannot learn that any have been seen since. Twenty-two mature fish were brought from the East in July, 1879, and placed by us in the Crystal Spring Reservoir, of the Spring Valley Water Company, in San Mateo County, with the assurance, on the part of the officers of that company, that the lake would be preserved and no fish allowed to be caught until the Fish Commissioners granted permission; and, with the further promise that, if the fish increased, the State could at all times take them for public distribution. These fish have done well, and are rapidly increasing in numbers. In another year the young can be caught and distributed to appropriate waters.

The Sportsman's Club, of San Francisco, have also imported a number of these fish and placed them in a lake in Alameda. We are pleased to learn that these also have increased in numbers.

STRIPED BASS—ROCCUS LINEATUS.

The one hundred and fifty striped bass brought in 1879, and placed in the water in the Straits of Carquinez are probably increasing. One of these fish was caught in the bay near Saucelito, and brought to market and identified. We have heard of a few others having been captured at Monterey, and near Alameda. This is one of the most valuable ocean and riverfish of the Atlantic coast, and supplies a large amount of food to the people of the Eastern States. There is now no doubt they will thrive in our waters, and we shall make every exertion to obtain large numbers, so that, in time, our bays and brackish waters, at the mouth of our rivers, may be fully stocked.

LOBSTERS AND EELS.

The twenty-four mature lobsters, to which were attached about two million eggs nearly ready to hatch, brought from the Atlantic in 1879, were placed in a sheltered cove near the Golden Gate. No person, so far as we can learn, has as yet tried to capture any of them, and none have been accidentally caught. As all the conditions seemed favorable, we have no doubt the young are growing, and that, during the coming Summer, we shall hear of California lobsters having been taken and brought to market.

Occasionally we hear of an eel being captured, but as yet they have not showed an increase in proportion to that of other imported fish.

EASTERN AND CALIFORNIA TROUT.

We each Winter hatch the eggs of large numbers of both these varieties of trout, and distribute them in streams in different parts of the State. The South Yuba and the North Fork of the American Rivers, which originally contained no fish above the high falls on each stream, are now well stocked with both kinds of trout. We have also stocked other streams, which naturally contained no fish, or from which all the fish had been caught.

FISH-WAYS.

Whenever we have learned that the passages for fish are obstructed by artificial dams in any streams, we have notified the owners of such obstructions to remove them, or construct fish-ways, so as to permit the free passage of fish. When the owners neglect or refuse to comply with the law, we place the matter in the hands of the District Attorney of the county for prosecution. The law controlling the subject is deemed wise and beneficial, and only in a few cases has it been found necessary to do more than call the attention of the offending parties to its requirements.

At the last session of the Legislature an Act was passed "To provide for removing obstructions in Pit River, above the mouth of Hat Creek, so as to enable salmon to reach the spawning grounds on the upper waters of said river and its tributaries."

At the place designated on the Pit. there is a fall of forty-one feet. The salmon in vast numbers reach the foot of this fall, and are now unable to pass. If a passage were made over this fall through which the fish could pass, they would find on the upper waters of the Pit and its tributaries, between two and three hundred miles of unobstructed spawning grounds. This would make an area of spawning ground equal to that now used by salmon in all the other tributaries of the Sacramento. Therefore, the removal of this obstruction should, in a few years, even if artificial propagation were discontinued, more than double the present number of salmon annually visiting the

Sacramento River. In addition, a passage for fish over this natural obstruction would give the rapidly increasing population of the northeastern portion of the State an abundance of fish. This Act provides that the Fish Commissioners should advertise for proposals, and let a contract for a fish-way over this fall, and makes an appropriation of three thousand dollars, with which to pay the cost and incidental expenses of this work.

As a preliminary to advertising, we appointed A. W. Von Schmidt, from his known reputation as a civil engineer, to make a survey and sketch of this fall, so that of the various fish-ways in use that best adapted to the situation might be selected. On the approval of his plan, an advertisement was published in different newspapers, as required by law. When the bids were opened, it was found that the lowest was that of Mr. S. C. Mooers, for $2,100. Contracts, in duplicate, were made out and sent to him for his signature. After some weeks he wrote, stating that he could not do the work for the amount of his bid. We then wrote to E. E. Van Sickel, F. H. Kenyon, and W. H. Kenyon, the only other bidders, who had proposed to do the work for $2,300, stating the facts as to Mooers' refusal, and asked them if they would contract to do the work, during the coming Summer, for the amount of their bid, $2,300. They replied that they would, and contracts have been signed by them, dated January 5, 1881. The work is to be completed between August 1, and November 1, 1881.

This Act is peculiarly worded. Section four says: "When the work is completed, approved, and accepted by the Fish Commissioners, they shall certify the amount due upon said contract or contracts, and the amount due for advertising and other necessary expenses incurred by them in carrying out the provisions of this Act to the State Board of Examiners, and when approved by said Board, the amount shall be paid out of the General Fund in the State treasury."

The Controller construes this Act to mean that none of the incidental expenses, such as surveying and advertising, can be paid until the whole work is completed. These necessary expenses, preliminary to letting the contract, amount to about $250, and, as the persons who have performed the work should be paid for their services, we have to request that a supplemental Act should be passed, allowing the Board of Examiners to audit these accounts, and the Controller to draw his warrant on the appropriation made for this purpose.

BAY AND COAST FISH.

Accompanying this will be found a report from Mr. W. N. Lockington giving a general and popular description of the most important of the fishes hitherto discovered in the inland and coast waters of the Pacific Coast, U. S. A. In this work he has had the benefit of the notes and discoveries of Professors Jordan and Gilbert, who, as the representatives of the Smithsonian Institute and the United States Census Bureau, have been engaged on this coast, during the past summer, in studying its fish fauna. Many of these fishes are known only by descriptions lately published in the Proc. U. S. Nat. Museum. Mr. Lockington's statements of the habits and migrations, as well as of the places, upon our coast, where particular varieties of food fish are most abundant, if studied by our fishermen, would be of service in promoting their industry. His statistics and investigations in connection with the rapidly increasing codfish business of this coast have much interest in showing that the codfish banks are probably as extensive and inexhaustible as those of Newfoundland. As population increases on the Pacific Coast and new markets are found for the cured fish, this industry will be found capable of great enlargement, and thus promote varied industries and furnish employment to a large number of men and boys.

APPROPRIATION AND EXPENDITURES.

There is herewith appended a detailed account of the appropriation received and expenditures incurred since our last report. We have sought to exercise the greatest economy consistent with the work to be performed. With the experience we have obtained during ten years, it is believed that no money has been expended in doubtful experiments. We now know that the money of the people appropriated for fish culture is resulting in the production of a large increase of valuable and nutritious food, which is sold to the consumers at low prices. We also know that fish culture, by the State, is adding to the industries of the people and increasing the public wealth.

It is with gratification we add that our work seems to be appreciated by the public as one of increasing importance. We are looking for the time when the public will also appreciate the necessity of sustaining the officers of the law in performing their duties in restraining illegal fishing.

REPORT

UPON THE

EDIBLE FISHES OF THE PACIFIC COAST, U. S. A.

BY W. N. LOCKINGTON.

Since the publication of the last report of the Fish Commissioners of this State, more than forty new species have been described, the greater part of them by Professor D. S. Jordan and his assistant, Mr. Gilbert, both of the United States Fish Commission. Beside these hitherto unknown forms, our fauna has been enriched by the discovery of the occurrence upon our coast of numerous previously known species of pelagic habits, most of them either belonging to the Elasmobranchii (sharks and rays), or to the mackerel and allied families.

These discoveries, notwithstanding the elimination of several nominal species, raise the total number of California fishes to two hundred and seventy-eight.

If to this number are added thirty-four species occurring in Oregon and Washington Territory, and not yet recorded from our State, we arrive at a grand total of three hundred and twelve species belonging to the Pacific Coast of the United States.

This number includes the native species only; but the following introduced species are of more or less frequent occurrence in our markets, and must be considered as forming part of our supply of food fishes: Striped Bass, *Roccus lineatus;* Shad, *Alosa sapidissima;* Common Carp, *Carassius vulgaris;* Catfish (two species), *Amiurus catus, Amiurus albidus.*

Several other Eastern species have been introduced, but have not yet become of common occurrence.

For the greater portion of the facts brought together in the following pages, I have to thank Professor D. S. Jordan, who kindly placed his notes at my disposal, and assisted me in many other ways, and his indefatigable assistant, Mr. C. Gilbert. These gentlemen have made a more thorough investigation of the fish fauna of our coast than has ever been made before, so that the present year has been more fruitful in facts of scientific and economic interest than any preceding one since the date of publication of the explorations and surveys for a railroad route from the Mississippi to the Pacific.

My own observations have necessarily been for the most part confined to the neighborhood of San Francisco; the supply brought to the markets of this city; and the specimens in various collections, especially that of the California Academy of Sciences.

LIST OF THE FISHES OF THE STATE OF CALIFORNIA.

ABBREVIATIONS USED.

F. W.	Fresh water.	Blank.	Entire coast.
C. S.	Point Concepcion, southward.	F.	Monterey and San Francisco.
C. N.	Point Concepcion, northward.	F. S.	San Francisco, southward.
E. S.	Entire coast, commonest south.	F. N.	San Francisco, northward.
E. N.	Entire coast, commonest north.	S. D.	San Diego, southward.
P. S.	Puget Sound.	B. N.	Santa Barbara, northward.

ORIGINAL DESCRIBERS.

Gir.	Girard.	Pal.	Pallas.
J. & G.	Jordan and Gilbert.	Cuv.	Cuvier.
Ay.	Ayres.	Val.	Valenciennes.
Ln.	Lockington.	L.	Linneus.
Cr.	Cooper.	Ag.	Agassiz.
Str.	Steindachner.	Rich.	Richardson.
Gnth.	Günther.	Raf.	Rafinesque.
B. & G.	Baird and Girard.	Walb.	Walbaum.

Other names are written in full.

PLECTOGNATHI.

Orthagoriscidæ—	
Mola rotunda, Cuv.	F. S.
Diodon maculatus, Lac.	S. D.
Tetrodontidæ—	
Tetrodon politus, Gir.	S. D.

LOPHOBRANCHII.

Syngnathidæ—	
Syngnathus punctipinnis, Gill.	C. S.
Syngnathus californiensis, Storer	B. N.
Syngnathus dimidiatus, Gill.	C. S.
Syngnathus leptorhynchus, Gir.	S. D.
Hippocampidæ—	
Hippocampus ingens, Gir.	S. D.

HEMIBRANCHII.

Gasterosteidæ—	
Gasterosteus aculeatus var. serratus, Ay.	F. N.
Gasterosteus microcephalus, Gir.	
Eucalia williamsoni, Gir.	F. W.
Aulorhynchidæ—	
Aulorhynchus flavidus, Gill	C. N.

HETEROSOMATA.

Pleuronectidæ—	
Hippoglossus vulgaris, Fleming	F. N.
Hippoglossoides jordani, Ln.	C. N.
Hippoglossoides exilis, J. & G.	C. N.
Atheresthes stomias, J. & G.	F.
Psettichthys melanostictus, Gir.	C. N.
Paralichthys maculosus, Gir.	F. S.
Xystreurys liolepis, J. & G.	C. S.
Citharichthys sordidus, Gir.	
Glyptocephalus zachirus, Ln.	F.
Cynicoglossus pacificus, Ln.	C. N.
Pleuronectes stellatus, Pal.	C. N.
Pleuronichthys decurrens, J. & G.	F.
Pleuronichthys coenosus, Gir.	E. N.
Pleuronichthys verticalis, J. & G.	F.
Hypsopsetta guttulata, Gir.	F. S.
Parophrys vetulus, Gir.	B. N.
Parophrys isolepis, Ln.	F. N.
Lepidopsetta bilineata, Ay.	C. N.
Aphoristia atricauda, J. & G.	S. D.

ANACANTHINI.

Gadidæ—

Microgadus proximus, Gir.	C. N.
Pollachius chalcogrammus, Pal.	C. N.
Merlucius productus, Ay.	B. N.
Brosmophycis marginatus, Ay.	F.

Ophidiidæ—

Ophidium taylori, Gir.	B. N.

Zoarcidæ—

Lycodopsis paucidens, Ln.	F.
Lycodopsis pacificus, Collett	F. N.

ACANTHOPTERI.

Blennidæ—

Cebedichthys violaceus, Gir.	C. N.
Anarrhichthys ocellatus, Gir.	C. N.
Anoplarchus atropurpureus, Kittlitz	C. N.
Murænoides nebulosus, Schlegel	C. N.
Murænoides lætus, Cope	C. N.
Apodichthys flavidus, Gir.	C. N.
Apodichthys fucorum, J. & G.	C. N.
Xiphïster mucosus, Gir.	C. N.
Xiphïster chirus, J. & G.	C. N.
Xiphïster rupestris, J. & G.	C. N.
Lumpenus anguillaris, Pal.	F. N.
Cremnobates monophthalmus, Gnthr.=integripinnis, Ros. Smith	S. D.
Gibbonsia elegans, Cr.	F. S.
Heterostichus rostratus, Gir.	F. S.
Neoclinus satiricus, Gir.	F. S.
Neoclinus blanchardi, Gir.	F. S.
Hypleurochilus gentilis, Gir.	C. S

Batrachidæ—

Porichthys porosissimus, Cuv. & Val.	

Trachinidæ—

Icosteus ænigmaticus, Ln.	F. N.
Icichthys lockingtoni, J. & G.	F.
Caulolatilus anomalus, Cr. (=princeps?)	F. S.
Trichodon stelleri	F. N.

Trachypteridæ—

Trachypterus altivelis? Kner.	F. N.

Liparididæ—

Liparis pulchellus, Ay.	C. N.
Neoliparis mucosus, Ay.	C. N.

Gobiesocidæ—

Gobiesox reticulatus, Gir.	C. N.

Gobiidæ—

Gillichthys mirabilis, Cr.	M. S. (and N.?)
Lepidogobius gracilis=Gobius lepidus, Gir.	F. N.
Lepidegobius newberryi, Gir.	?
Crystallogobius eos, Rosa Smith	S. D.

Agonidæ—

Podothecus vulsus, J. & G.	F.
Podothecus trispinosus, Ln.	E. S.
Brachyopsis verrucosus, Ln.	F.
Brachyopsis xyosternus, J. & G.	F.

Triglidæ—

Prionotus stephanophrys, Ln.	F.

Cottidæ—

Artedius pugettensis, Str.	F. N.
Artedius quadriseriatus, Ln.	F.
Artedius lateralis, Gir.	F. N.
Artedius notospilotus, Gir.	B. N.
Hemilepidotus spinosus	F.
Hemilepidotus gibbsii, Gill	F. N.
Leptocottus armatus, Gir.	
Aspicottus bison, Gir.	F. N.
Liocottus hirundo, Gir.	C. S.

Oligocottus globiceps, Gir.	C. N.
Oligocottus maculosus, Gir.	C. N.
Oligocottus analis, Gir.	F. S.
Scorpænichthys marmoratus, Hy.	
Uranidea gulosus, Gir.	F. W.
Uranidea asper (Rich) Gir.	F. W.
Ascelichthys rhodorus, J. & G.	F. N.
Blepsias cirrhosus, Pal.	F. N.
Nautichthys oculo-fasciatus, Gir.	F. N.
Chiridæ—	
Zaniolepis latipinnis, Gir.	F. N.
Oxylebius pictus, Gill	F. N.
Myriolepis zonifer, Ln.	F.
Chirus decagrammus, Pal.	C. N.
Chirus pictus, Ay.	F. N.
Ophiodon elongatus, Gir.	C. N.
Anoplopoma fimbria, Pal.	F. N.
Scorpænidæ—	
Scorpæna guttata, Gir.	C. S.
Sebastichthys nigrocinctus, Ay.	F. N.
Sebastichthys serriceps, J. & G.	F. S.
Sebastichthys chrysomelas, J. & G.=fasciatus, Gir.	F. S.
Sebastichthys nebulosus, Ay.	F. N.
Sebastichthys carnatus, J. & G.	F. S.
Sebastichthys maliger, J. & G.	F. N.
Sebastichthys caurinus, Rich. Var. vexillaris, J. & G.	E. N.
Sebastichthys rastrelliger, J. & G.	F. S.
Sebastichthys auriculatus, Gir.	B. N.
Sebastichthys rubrivinctus, J. & G.	B. N.
Sebastichthys ruber, Ay.	B. N.
Sebastichthys constellatus, J. & G.	B. N.
Sebastichthys rosaceus, Gir.	B. N.
Sebastichthys rhodochloris, J. & G.	F.
Sebastichthys chlorostictus, J. & G.	F.
Sebastichthys miniatus, J. & G.	F. S.
Sebastichthys pinniger, Gill	F. N.
Sebastichthys atrovirens, J. & G.	F. S.
Sebastichthys elongatus, Ay.	F.
Sebastichthys proriger, J. & G.	F.
Sebastichthys ovalis, Ay.	F. S.
Sebastichthys entomelas, J. & G.	F.
Sebastichthys mystinus, J. & G.=Sebastodes melanops, Ay.	
Sebastichthys ciliatus, Tilesius=melanops, Grd.=simulans, Gill	F. N.
Sebastichthys flavidus, Ay.	F. S.
Sebastodes paucispinis, Ay.	F. S.
Stromateidæ—	
Stromateus simillimus, Ay.	
Carangidæ—	
Caranx caballus, Gnthr.	C. S.
Trachurus saurus, Raf.	F. S.
Seriola lalandi, Cuv. & Val.	C. S.
Echeneididæ—	
Remora jacobæa, Lowe	F.
Echeneis naucrates, L.	F.
Xiphiidæ—	
Xiphias gladius, L.	C. S.
Scombridæ—	
Scomber pneumatophorus, De la Rochë	F. S.
Scomber scombrus, L,	Straying to Santa Catalina Id.
Scomberomorus concolor, Ln.	F.
Sarda chilensis, Cuv. & Val.=Pelamys lineolata, Grd.	F. S.
Orcynus alalonga, Gmelin	F. S.
Orcynus pelamys? (sp. not seen.) Ln.	C. S.
Coryphænidæ—	
Coryphæna hippurus? L.	Cayucos.
Pomacentridæ—	
Hypsipops rubicundus, Gir.	C. S.
Chromis punctipinnis, Cr.	C. S.
Chromis atrilobata, Gill	C. S.

Labridæ—	
Platyglossus semicinctus, Ay.	C. S.
Pseudojulis modestus, Gir.	F. S.
Pimelometopon pulcher, Ay.	F. S.
Embiotocidæ—	
Hypsurus caryi, Ag.	F. S.
Ditrema jacksoni, Gir.	
Ditrema laterale, Ag.	B. N.
Ditrema atripes, J. & G.	F.
Ditrema furcatum, Gir.	F. S.
Damalichthys argyrosomus=vacca, Gir	E. N.
Amphistichus argenteus, Ag.	F. S.
Rhacochilus toxotes, Ag.	F. S.
Holconotus rhodoterus, Ag.	F. S.
Holconotus argenteus, Gibbons	F. S.
Holconotus agassizii, Gill	B. N.
Holconotus analis, A. Ag.	C. N.
Cymatogaster aggregatus, Gibbons	E. N.
Brachyistius frenatus, Gill	
Brachyistius rosaceus, J. & G.	F.
Abeona minima, Gibbons	F. S.
Abeona aurora, J. & G.	F.
Hysterocarpus traskii, Gibbons	F. W.
Sciænidæ—	
Corvina saturna, Gir.	C. S.
Roncador stearnsii, Str.	C. S.
Genyonemus lineatus, Ay.	F. S.
Umbrina xanti, Gill	C. S.
Cynoscion parvipinnis, Ay.	C. S.
Cynoscion nobilis, Ay.	F. S.
Seriphus politus, Gir	F. S.
Menticirrus undulatus, Gir.	C. S.
Ephippidæ—	
Parephippus faber, Bloch=Ephippus zonatus, Gir.	F. S.
Separidæ—	
Girella nigricans, Ay.	F. S.
Scorpis californiensis	F. S.
Percidæ—	
Xeiechthys californiensis, Str.	S. D.
Pristipoma davidsoni, Str.	C. S.
Stereolepis gigas, Ay.	F. S.
Serranus clathratus, Gir.	F. S.
Serranus nebulifer, Gir.	F. S.
Serranus maculofasciatus, Str.	C. S.
Archoplites interruptus, Gir.	F. W.
Ammodytidæ—	
Ammodytes personatus, Gir.	F. N.
Sphyrænidæ—	
Sphyræna argentea, Gir.	F. S.

PERCESOCES.

Atherinidæ—	
Atherinopsis californiensis, Gir.	F. S.
Atherinops affinis, Ay.	C. S.
Leuresthes tenuis, Ay.	S. D.
Mugilidæ—	
Mugil mexicanus, Str.	F. S.

SYNENTOGNATHI.

Scomberesocidæ—	
Scomberesox brevirostris, Peters	F. S.
Tylosurus exilis, Gir.	C. S.
Hemiramphus rosæ, J. & G.	C. S.
Exocætus californiensis, Cr.	C. S.

HAPLOMI.

Cyprinodontidæ—	
Fundulus parvipinnis, Gir.	C. S.
Cyprinodon californiensis, Gir.	S. D.

ISOSPONDYLI.

Synodontidæ—	
Synodus lucioceps, Ay.	F. S.
Paralepidæ—	
Sudis ringens, J & G.	C. S.
Scopelidæ—	
Myctophum crenulare, J. & G.	C. S.
Alepidosauridæ—	
Alepidosaurus borealis, Gill	F. N.
Salmonidæ—	
Osmerus thaleichthys, Ay.	C. N.
Osmerus attenuatus, Ln.	F.
Hypomesus olidus, Pal.	F. N.
Oncorhynchus keta, Walb.=tsuppitch, Rich.	Sac. Riv. N.
Oncorhynchus gorbuscha, Walb.	Sac. Riv. N.
Oncorhynchus quinnat, Rich.	Ventura Riv. N.
Oncorhynchus kisutch, Walb.=canis, Suckley	Sac. Riv.
Salar mykiss, Walb.	Riv. of Mont. Bay, N.
Salar irideus, Gibbons	F. W.
Salar henshawi, Gill & Jor.	Lake Tahoe, etc.
Salar clarki, Rich.	Riv. of Mont. Bay, N.
Salvelinus malma, Walb.=spectabilis, Gir.	F. W.
Coregonus williamsoni, Gir.	Lake Tahoe.
Clupeidæ—	
Albula vulpes, L.	F. S.
Clupea mirabilis, Gir.	E. N.
Clupea sagax, Jenyns	F. S.
Stolephorus ringens, Jenyns	E. S.
Stolephorus compressus, Gir.	C. S.
Stolephorus delicatissimus, Gir.	S. D.

EVENTOGNATHI.

Catostomidæ—	
Catostomus occidentalis, Gir.	F. W.
Catostomus labiatus, Ay.	F. W.
Catostomus tahoensis, J.	F. W.
Cyprinidæ—	
Orthodon microlepidotus, Ay.	F. W.
Gila conformis, B. & G.	F. W.
Gila grandis, Ay.	F. W.
Gila rapax, Gir.	F. W.
Siboma crassicanda, Gir.	F. W.
Myloleucus bicolor, Gir.	Klamath Lake.
Myloleucus formosus, Gir.	F. W.
Cheonda crassa, Gir.	F. W.
Lavinia exilicanda, B. & G.	F. W.
Lavinia harengus, Grd.	F. W.
Lavinia gibbosa, Ay.	F. W.
Notemigonus occidentalis, B. & G.	F. W.
Pogonichthys inæquilobus, B. & G.	F. W.
Pogonichthys symmetricus, B. & G.	F. W.
Pogonichthys argyriosus, B. & G.	F. W.
Mylopharodon conocephalus, Ay.	F. W.

APODES.

Murænidæ—	
Muræna mordax, Ay.	C. S.
Myrichthys tigrinus, Gir.	Humboldt Bay.
Ophisuridæ—	
Ophichthys triserialis, Kaup.	C. S.

CHONDROSTEI.

Acipenseridæ—	
Acipenser transmontanus, Rich.	F. N.
Acipenser medirostris, Ay.=A. acutirostris, Gnthr.	F. N.

CLASS ELASMOBRANCHII.

HOLOCEPHALI.

Chimæridæ—	
Chimæra colliei, Bennett	C. N.

PLAGIOSTOMI.

Dasybatidæ—	
Urolophus halleri, Cr.	C. S.
Pteroplatea marmorata, Cr.	C. S.
Dasybatis dipterurus, J. & G.	S. D.
Myliobatidæ—	
Myliobatis californicus, Gill	F. S.
Ætobatis laticeps, Gill	?
Cephalopteridæ—	
Manta birostris, Walb.	S. D.
Raiidæ—	
Raia cooperi, Gir.	C. N.
Raia binoculata, Ay.	F.
Raia rhina, J. & G.	C. N.
Raia stellulata, J. & G.	F.
Zapteryx exasperatus, J. &. G.	S. D.
Rhinobatidæ—	
Rhinobatus productus, Ay.	F. S.
Rhinobatus triseriatus, J. & G.	F. S.
Torpedinidæ—	
Torpedo californica, Ay.	F.

SYUALI.

Squatinidæ—	
Squatina angelus, Dumeril	F. S.
Heterodontidæ—	
Heterodontus francisi, Gir.	C. S.
Hexanchidæ—	
Notorhynchus maculatus, Ay.	F. N.
Hexanchus corinus, J. & G.	F. N.
Alopecidæ—	
Alopias vulpes, Gmelin	F.
Scylliidæ—	
Catulus ventricosus, Garman	F. S.
Lamnidæ—	
Isurus oxyrhynchus, Raf.	C. S.
Carcharodon carcharias, L.=rondeletii, Muller & Henle	F. S.
Lamna cornubica, Gmelin	
Cetorhinidæ—	
Cetorhinus maximus, L.	F.
Galeorhinidæ—	
Galeorhinus galeus, L.	F. S.
Galeocerdo tigrinus, Muller & Henle	S. D.
Carcharinus glaucus, L.	F. N.
Eulamia lamia, Risso	S. D.
Triacis semifasciatus, Gir.	
Rhinotriacis henlei, Gill	F.
Mustelus hinnulus, Blainville	F. S.
Sphyrnidæ—	
Sphyrna zygæna, L.	S. D.
Spinacidæ—	
Squalus acanthias, L.	C. N.

MARSIPOBRANCHII.

Petromyzontidæ—	
Entosphenus tridentatus, Rich	F. N.
Ammocœtes plumbeus, Ay.	F. N.
Myxinidæ—	
Polistotrema dombeyi, Muller=Bdellostoma stouti, Ln	F. N.

CIRROSTOMI.

Branchiostomatidæ—	
Branchiostoma lanceolatum	S. D.

FISHES OF OREGON AND WASHINGTON TERRITORY,

NOT YET ON RECORD, FROM THE COAST OF CALIFORNIA.

Heterosomata—	
Hippoglossoides elassodon, J. & G.	P. S.
Parophrys ischyrus, J. & G.	P. S.
Anacanthini—	
Gadus morrhud, Tilesius	P. S.
Scytalina cerdale, J. & G.	P. S.
Trachinidæ—	
Bathymaster signatus, Cope	P. S.
Gobiidæ—	
Liparis cyclopus, Gnthr	?
Discoboli—	
Eumicotremus orbis, Gill	Vancouver Id.
Agonidæ—	
Aspidophoroides inermis, Gnthr.	
Podothecus acipenserinus, Pal.	Puget Sd. N.
Bothragonus swani, Str.	?
Cottidæ—	
Psychrolutes paradoxus, Gnthr.	?
Cottus polyacanthocephalus, Pal.	Puget Sd.
Chiridæ—	
Chirus stelleri, Tilesius	Puget Sd. N.
Chirus nebulosus, Gir.	?
Scorpænidæ—	
Sebastichthys caurinus, Rich.	P. S.
Paralepidæ—	
Paralepis coruscans, J. &. G.	P. S.
Scopelidæ—	
Myctophum procellarum, Bean	?
Salmonidæ—	
Thaleichthys pacificus	Columbia R. and P. S.
Oncorhynchus nerka, Walb.	Columbia R. and P. S.
Oncorhynchus kennerlyi, Suckley	Columbia R. and P. S.
Murænidæ—	
Nemichthys avocetta, J. & G.	P. S.
Scymnidæ—	
Somniosus microcephalus, Bloch	P. S.

EVENTOGNATHI.

Catostomidæ—	
Catostomus longirostris, Le Sueur	F. W.
Catostomus macrochilus, Gir.	F. W.
Lypomyzon luxatus, Cope	F. W.
Lypomyzon brevirostris, Cope	F. W.

CYPRINIDÆ.

Gila bicolor, Grd.	Klamath Lake, Or.
Gila oregonensis, Rich.	F. W.
Cheonda cooperi, Gir.	F. W.
Cheonda cœrulea, Gir.	F. W.
Richardsonius balteatus, Rich.	F. W.
Richardsonius lateralis, Gir.	F. W.
Apocope nubilus, Gir.	F. W.
Mylochilus caurinus, Rich.	F. W.

The fishes, the names of which are printed in italics, are not included in the published list by Messrs. Jordan and Gilbert in the Proc. U. S. Nat. Mus., because not seen by them, yet by reliable report occur in our waters. It is probable that several additional species of pelagic fishes, especially those of the mackerel and allied families, will be found to occur at San Diego, the marine fauna of which place is largely that of Lower California.

The ranges given for the species must not be regarded as final, but simply as the range now on record. As there is no fishery of any importance between Tomales Bay and the mouth of the Columbia, it is probable that several species now believed to be extra-Californian occur in the northern part of our State, and that many not on record north of San Francisco extend much farther northward.

HETEROSOMATA—FLATFISHES.

Much additional information respecting the flatfishes of the Pacific Coast has been gathered together since the date of the last report. The thirteen species there enumerated have, by the researches of Professor D. S. Jordan, been increased to twenty-one, seventeen of which are known to occur, more or less frequently, in the markets of San Francisco, and nineteen on the coast of California. Three species of the genus *Hippoglossoides* are now known, as well as three of *Pleuronichthys*, and the species of *Parophrys* are increased from one to three, but all the other species are the sole representatives of their genera upon this coast.

It is the custom of the dealers to lump together all the flatfishes, except the two kinds called halibut, that known as "turbot," and *Pleuronectes stellatus*, commonly called the flounder, and to sell them all at the same price. Yet it is tolerably well known that the Turbot (*Hypsopsetta guttulata*), the Black-dotted Sole (*Psettichthys melanostictus*), and the Long-finned Flounder (*Glyptocephalus zachirus*) are superior to the others for the table.

Hippoglossus vulgaris, Halibut—The halibut of this coast is now known to be identical with that of the Atlantic. The Farallone Islands and Monterey appear to be the most southern point at which this fish is found, but it becomes abundant off Cape Mendocino and Humboldt Bay, and more so northward of California. It is essentially a northern species, and in Europe occurs around the coasts of England and Ireland, but becomes more abundant at the Orkneys, and is common on the coasts of Norway and Iceland. On the Atlantic coast its southern limit appears to be Massachusetts Bay. It will be seen that on the Pacific Coast its range extends further southward than in the Atlantic, a fact probably accounted for by the equable temperature of the ocean along the coast from San Francisco to the Columbia. The mean Summer temperature of the ocean at the Golden Gate is 58° Far., while at the mouth of the Columbia it is 60°, or slightly higher. In the Winter it is 53° off the Golden Gate, and 50° off the mouth of the Columbia. Thus it is evident that the temperature off the Golden Gate cannot be very unsuitable to fish that are at home off the mouth of the Columbia. The halibut is a deep water fish, and does not enter land-locked bays like those of Humboldt or Tomales.

When the large and abundant supply of this fish is considered, it is a matter of wonder that so small a quantity is smoked or canned for market. There is a prejudice in favor of Eastern halibut, which, doubtless to some extent, hinders the development of this branch of business. The North Pacific Canning Company can some halibut at Klawack, Prince of Wales Island, and it is said to be of good quality.

The endeavor to bring fresh halibut to San Francisco from Puget Sound does dot appear to have been financially successful. A schooner load suddenly brought into a market already fully stocked with fish caused the price to fall to about ten cents per pound, and much of it could not be disposed of at that price.

Professor Jordan mentions a large halibut bank near Cape Flattery, and states that considerable numbers are taken with hook and line in the deeper channels of Puget Sound, north of which point it comes more abundant. It feeds upon large fishes, such as codfish.

Hippoglossoides jordani, Large-eyed Flounder—It appears strange that this common species should have escaped the notice of naturalists until last year. In the markets of San Francisco it abounds throughout every month of the year, and in Monterey Bay is the most abundant of its tribe. Professor Jordan informs me that about 500 pounds weight of this fish are taken daily at Monterey alone by the Chinese, besides large quantities taken by the Italians. An examination of the stock in trade of the Chinese located near Monterey, proved that over nineteen-twentieths of the fish that dry on hurdles and flap in the wind around the hovels consisted of this fish; a few sharks, with *Psettichthys melanostictus* and *Citharichthys sordidus* constituting the remainder.

It occasionally reaches sixteen inches or more in length, and a weight of five pounds, and is considered one of the best of its tribe, but is inferior to the black-dotted flounder, the turbot, and one or two others. It becomes rare northward, yet occurs in Puget Sound; south of Monterey it is not on record.

Hippoglossoides exilis, Large-scaled Flounder — This species is readily distinguished from the preceding by its much more slender form, and by the large size of the scales, which are very delicately ciliate on their hinder edge. The eyes are very large, their longitudinal diameter contained about 3⅓ times in the length of the head. The greatest depth is contained about 3½ times in the total length.

In July it was tolerably common in the markets of San Francisco, and its previous rarity is probably occasioned by the fact that it is only taken in tolerably deep water, and is too small to be considered of much value.

The specimens I have seen were from eight to ten inches in length, and three quarters of a pound in weight. It occurs in Puget Sound, but is not very common.

Hippoglossoides classodon—Unlike the two preceding species, this has only a single row of small teeth in the upper jaw. The scales are small, so that it can readily be distinguished from *H. exilis*, while from *H. jordani* it differs externally in the more strongly ciliated scales, and slightly more anterior origin of the dorsal fin.

The example in Mus. Cal. Ac. Sci. was taken by Professor Jordan at Seattle, at which port and at Tacoma he reports it as tolerably abundant. It reaches a length of one foot, and a weight of about two pounds.

Atheresthes stomias, the Hook-toothed Flounder—Isolated examples of this species, of fifteen to eighteen inches in length, have several times occurred in the markets of San Francisco during this year, but do not appear to have been noticed previously.

In form it is extremely slender, the greatest width scarcely extending one fourth of the total length, and tapering rapidly toward both extremities. The head enters about four and a half times in the total length, and is narrow, with an immense mouth, the upper jaw of which exceeds in length the one half of that of the head. The eyes are almost even in front, the upper one placed almost across the top of the head, and looking toward the dorsal outline. The teeth are numerous, in a double row in both jaws, irregular in size, hooked incurved canines interspersed among smaller upright teeth. The scales are large and soft, resembling in their character those of *Citharichthys sordidus*, and the color is a dirty yellow.

Very few examples have yet been found in our markets, and most of these have been secured for scientific purposes.

The range of this species is not ascertained.

Glyptocephalus zachirus, Long-finned Flounder—Up to the present time this species is only known from the markets of San Francisco, to which it is brought from deep water near Point Reyes, some thirty miles north of the city. It is comparatively rare, seldom more than three or four are offered for sale on any one day, and it is not brought in at all in the winter. It attains a length of eighteen inches, and a weight of about two pounds, and is held in high esteem. Hitherto it is only known to occur in Monterey Bay and in the vicinity of San Francisco. As its mouth is too small for the hook, and its habitat too deep for the gill-nets, it is taken chiefly in sweep-nets.

Cynicoglossus pacificus, Short-finned Flounder—This is the *Glyptocephalus pacificus* of the report of the Fish Commissioners for 1879. It is usually brought to market from the same place as the preceding species, but is known to occur at other points from Monterey to Puget Sound. It occurs in the market much more abundantly than the last species, yet the adults cannot be said to be common. In size and flavor it does not equal *G. zachirus*. When fresh it is excessively slimy to the touch.

Pleuronichthys decurrens, Bastard Turbot—The species described by me as *P. coenosus* Girard (Proc. U. S. Nat. Mus. 97, 1879) was there surmised to be the *Pleuronectes quadrituberculatus* of the old Russian naturalist Pallas. It differs from Girard's *coenosus* in the presence of tubercles upon the side of the head on the colored side. It is now known not to be Pallas' species, and has been named *decurrens* by Jordan and Gilbert.

This fish is now of more frequent occurrence in our markets than formerly, and becomes more abundant towards the south. It reaches about a foot in length, and a weight of from two to three pounds.

Pleuronichthys verticalis, Spine-cheeked Turbot—This form was first noticed as a separate species by Professor Jordan, and was described by him from specimens found in San Francisco market. In 1879 I obtained a small example of this fish, but did not venture to describe it as distinct, although some of its peculiarities are noted in my review of the Pleuronectidæ (Proc. U. S. Nat. Mus. 1879, 99).

The dorsal fin is not carried downwards on the blind side of the head so far as in the previous species; the cheek is without spines, the posterior extremity of the interorbital ridge is developed into a backward directed spine, and the anterior into two shorter upright spines. This species has occurred in our markets during the present year with tolerable regularity. In Monterey Bay it is of common occurrence, and attains a length and weight equal to the preceding.

Pleuronichthys coenosus—The *P. coenosus* of Girard proves to be a distinct species, and not, as surmised in my review of the Pleuronectidæ (Pro. U. S. Nat. Mus. 1879, 99) identical with the one known as *decurrens*. In this form there are no tubercles on the cheeks, and the dorsal fin is like that of *verticalis*, but the tubercles between the eyes are not developed into spines and the body is unspotted.

This fish is not often brought to the market of San Francisco, but occurs along the entire coast from Puget Sound to San Diego.

All the species of Pleuronichthys feed largely on algæ, with which their stomachs are found to be filled. In this particular they differ from the carnivorous habits of the other flounders. They all occur in deep water, and their increasing abundance in our markets shows that the depauperization of our bays and shallows is constantly forcing our fishermen into the depths.

Parophrys (*Isopsetta*) *ischyrus*—This is a course rough fish, in ist general appearance greatly resembling the "Flounder," (*Pleuronectes stellatus*) but differing from it in the ctenoid scales, and in the presence of an accessory lateral line, characters in which it agrees with the next species. It has hitherto been found only in Puget Sound, and reaches a length of about eighteen inches.

Parophrys (*Isopsetta*) *isolepis*, Rough Even-scaled Flounder—I established the genus *Isopsetta* to contain this species and the preceding, both of which have the characters of a nearly straight lateral line, and strongly ctenoid scales of equal development on head and body, but Prof. Jordan includes them in the same genus with the following species:

The examples brought to San Francisco market are usually small, but Professor Jordan informs me that it attains a length of fifteen inches, and a weight of three pounds. Its range extends to Puget Sound. Its occurrence in our markets is irregular, but occasionally it is abundant, being taken with sweep-nets off Point Reyes.

Parophrys vetulus—This species is abundant from San Francisco northward, becoming at Puget Sound the commonest of the flat fishes.

It has been taken by Professor Jordan at Santa Barbara, but appears to become rare south of Point Concepcion. Those brought to market are usually quite small, but occasional examples reach a length of fifteen inches, and a weight of two pounds, or more.

Lepidopsetta bilineata, Mottled Sole—The *Platichthys umbrosus* of Dr. Girard (U. S. P. R. R. Rep. X., 149 1858), is identical with the species described by Ayres, while the *Lepidopsetta umbrosa* described by me (Proc. U. S. Nat. Mus. 1879, 106), is the one since described as *Isopsetta isolepis*.

This species is found along our coast from Monterey to Alaska, is rather common about rocky places, and is abundant in Puget Sound.

In size and weight it is about equal to *Psettichthys melanostictus* and *Hippoglossoides jordani*, and in quality ranks with the latter.

Aphoristia atricauda, Black-tailed Sole—This fish, although apparently too rare to be of economic value, since the only specimens extant are about six in number, and do not exceed six inches in length, is interesting as the only species of true sole found in California waters.

The Soleidæ have been separated as a distinct family from the flounders by Dr. Gill, the chief distinguishing character being the smallness or absence of the pectorals. But as there is a regular gradation from species with large pectorals to those without any, this character is scarcely definite. In *Cynicoglossus* the pectorals are very small.

FAM. GADIDÆ—COD AND WHITING, ETC.

The Gadidæ are spineless fishes with cycloid or smooth scales, and usually with more than one dorsal and more than one anal fin. In economic importance this family ranks next to the salmon family, but it is only represented on the Pacific coast, U. S. A., by four species.

Gadus morrhua, Codfish—Although this fish does not belong to the fauna of California, and is not common even at the northern extremity of the Pacific coast of the United States proper, its economic importance renders it necessary to include it in this report. Dr. Bean, whose mission it has been to investigate the fishes of Alaska, believes the codfish of Alaska identical with *Gadus morrhua*, the common codfish of the banks of Newfoundland, and the adjacent regions; for the Alaskan cod is not a rock-cod (*Sebastichthys*), as are the so-called cod caught in California, nor is it even a hake, pollack, or whiting; but it is a true codfish, having three separate dorsal fins, two separate anal fins, and a small barbel under the chin.

It seems strange that such fishes as the species of *Sebastichthys*, possessed of rough or ctenoid scales, a spinous dorsal, three spines upon the anal fin, and numerous more or less developed spines on the head, should ever be popularly confounded with fishes like the true cod, which have not a spine upon body, head, or fins, and the scales of which are smooth or cycloid. Yet the confusion exists, and the names of cod and rock-cod, applied to the spiny fishes aforesaid, are the result of the confusion, and in their turn serve to perpetuate it.

Whether the cod-fish brought from the Sea of Okhotsh are of the same species as those from Alaska, remains to be proved.

Compared with the fishery of the Atlantic, that carried on upon this coast is comparatively insignificant, yet this does not arise from any scarcity of the fish, which is stated to abound among the numerous islands of the northwest coast, but from the want of a market sufficiently extensive to permit of its increase. The expense of transcontinental freight, and the smallness of the population between the Sierra Nevada and the Rocky Mountains practically limits the market to the Pacific States, although small quantities have been sent to South America, and some have been shipped to Australia.

The fishery was commenced about sixteen years ago, and at that date the salted fish sold at nine cents per pound. At the present time the best case cod is quoted at from three and a half to four cents per pound.

The total catch brought to San Francisco, amounted, in 1878, to about 1,500 tons, in 1879 to 1,800 tons. Thirteen or more vessels, large and small, are engaged in the trade, which furnishes employment, on an average, to about two hundred and fifty hands. The largest vessels are barks of about 350 tons, each having a crew of thirty men. The larger vessels are principally employed in the Okhotsh Sea fishery, while the smaller vessels, fore and aft rigged, are sent to the shores of Alaska, principally to the Choumagin Islands.

Those which go to the Okhotsh Sea make but one trip annually, leaving from the middle of March to the end of April, and returning from the end of June to October. Those which fish at the Choumagin Islands return earlier than those from the Okhotsh Sea, and occasionally take more than one trip. Last year one schooner made three trips, but her cargo each time was made up from the catch of other vessels that did not return. The smaller vessels are better fitted for the tortuous channels among the islands of Alaska than those of larger size.

On the coast of Alaska the fishery is usually carried on at depths of from ten to fifteen fathoms, but in the Sea of Okhotsh lines are used at forty to fifty fathoms. Both trawl lines and angle lines are used in the cod fishing of this coast. The latter are employed in deep water, the former where the depth is not too great, and the bottom is clear of rocks. Angle lines are exclusively used in the Sea of Okhotsh, and frequently also in Alaskan waters. A trawl line consists of a line to which a number of hooks are attached at regular distances by means of shorter lines, while a weight is secured to each end. Several trawl lines are paid out in succession, the position of each being indicated by means of buoys, one of which is fastened to each end of every trawl line. The trawls used in the Alaska cod fishery are often six hundred fathoms long (3,000 feet), and bear on each side a row of hooks at every half fathom, or thereabouts. After they are paid out, they are examined at intervals, and are drawn once or twice a day, according to the rate at which the fish take the bait.

An angle line bears two hooks, kept apart by a piece of wire, and has a heavy weight attached near the hooks. Each man manages two lines, one on each side of him, drawing one as soon as he lets down the other.

The use of the angle line instead of the trawl line in the Sea of Okhotsh is necessitated partly by the deep water, but partly by the abundance on the sand banks of a small crustacean, called by the fishermen a "sand flea," which attacks and devours the fish upon the trawl line before it can be drawn.

The fishermen are paid according to their catch, a fixed sum per thousand fish. At Kadiak, where some fishing is done, natives are employed to head, split, and salt the fish, and are paid from seventy-five cents to one dollar per day. The fish are treated in a manner similar to that employed in the Newfoundland fishery, the fish as they are caught are passed to the header, who removes the head; by him to the splitter, who cuts open the body and takes out the viscera. The catch is then stored in pickle, as the salted condition is called, until its arrival in the Bay of San Francisco, where it is dried in establishments erected for the purpose.

The quantity given above, as the total of the season's catch, does not include that taken by local fishermen along the various parts of the long line of coast between Behring's Strait and Puget Sound, at which latter place it is found, but in small quantity compared with its abundance in Alaskan waters.

The three principal firms engaged in the cod fishery, are Lynch & Hough, the Pacific Fish Company, and N. Bichardt & Co. The first named, which does a somewhat larger business than the second, carries on the fishery exclusively in the Sea of Okhotsh. It employs about one hundred and twelve men afloat, and from ten to fifteen at its drying establishment, which is situated at California City, near

San Quentin. When the bulk of the catch comes in, the force on the shore is increased to about sixty. At this establishment the fish is not dried in bulk, and then piled, as is done upon the Atlantic coast, and also in some cases on this coast, but is kept in pickle, in tanks of redwood lumber, and dried when required. This method is doubtless adopted partly on account of the limited demand caused by the small population of this coast, but it is claimed that better results are obtained by it. The piled up heaps of fish, however carefully dried, are liable in the more or less foggy atmosphere of our coast to "sweat" or ferment, to the great detriment of the article.

The tanks used to hold the stock are of redwood three inches thick, dovetailed at the angles, and without nails or any iron whatever. The fish are washed before drying, and when the latter process is complete, are sorted into three sizes; the largest, put up into wooden cases, are known as "case" fish, and fetch the highest price; the next size are made into bundles; while the smallest, after having been divested of skin, vertebræ, and fins, are cut in halves, packed in cases, and sold as "boneless codfish." Much of the work of preparing boneless cod can be done by boys. Great care is taken to insure perfect cleanliness at every step of the preparation, and in this respect much of the dried cod of this coast is certainly superior to that of Newfoundland.

The drying establishment of the Pacific Fish Company is situated upon a small island in Richardson's Bay, opposite to Saucelito.

The quality of preserved codfish depends, to a great extent, like that of all other salted articles, upon the quality of the salt used. The impurities, as they are called, of salt, are simply other ingredients naturally contained in sea water, and not taken out in the process of salt making. Ordinary sea water contains, besides common salt or chloride of sodium, sulphate of lime or gypsum (the material of plaster of Paris), and sulphate of magnesia. The proportions in which these enter into the composition of the solid residue, left after the evaporation of the water of the sea, may be seen from the following analysis: Analysis of water of San Francisco Bay, made December, 1879, by Prof. F. Gutzkow:

Chloride of sodium	0023.756
Chloride of potassium	0000.470
Chloride of magnesium	0003.030
Sulphate of lime	0001.263
Sulphate of magnesium (Epsom salts)	0001.837
Bromide of magnesium	0000.025
Total solids	0030.381
Water	969.619
	1000.000

The salt used in curing codfish, as well as most of that used in salting meats, hides, etc., is made upon the salt marshes of Alameda County by the evaporation of sea water. Some makers simply evaporate, allowing all the impurities to remain, while others, knowing the degree of concentration at which the objectionable substances are deposited, adopt means to obtain really pure salt. Whatever success may be obtained by others, a personal examination of the works and methods adopted at the Pacific Union Salt Works has convinced the writer that the salt obtained by them is as nearly pure as salt can be, excelling in this respect even the best Liverpool salt, and it is satisfactory to know that the greater portion of the codfish taken on this coast is cured with the salt made by this company.

The oil from the livers of these fish, which forms a valuable portion of the industry on the Atlantic coast, is not utilized here, nor are the "sounds," or swim bladders, put up for food purposes. As has been long ago remarked in the Atlantic, the fish occupying deep waters are superior to those found on the more accessible banks.

Merlucius productus, *Ay.*, Hake—The *Merlucius productus* of Ayres may prove to be identical with the *vulgaris* of the European coasts. Until lately the examples brought to the markets of this city seldom exceeded eighteen inches in length, but during the present summer the Italian fishermen of Monterey have frequently caught individuals of two feet or more in length, and some of these have found their way to San Francisco. In consequence of the stout form of this fish, and its thickness and depth in the pectoral region, its weight is proportionately large, reaching eight pounds, or even ten.

Pollachius chalcogrammus, *Pal.*, Pollack—This species, hitherto believed to be absent from the Californian coast, has lately been found in the market, to which it was brought from Monterey Bay. The only other Gadoid fish occurring in California is the well known Tom-cod (*Microgadus proximus*), which is not on record south of Monterey Bay, but ranges northward to Alaska.

CHIRIDÆ.

The somewhat heterogeneous group included under this title contributes at least seven species to the fauna of California, all of them of sufficient size, but only four of them sufficiently abundant for use as food. All have the character common to the *Chiridæ*, *Agonidæ*, *Cottidæ*, *Scorpænidæ*, etc., of a bony process uniting the suborbital ring with the preoperculum. Unlike the *Scorpænidæ*, and most of the *Cottidæ*, which have three and a half gills, the *Chiridæ* have four, and there is a slit behind the fourth—not present in *Scorpænids* (rock-cod), nor in some Cottoids. The dorsal and anal fins are usually long, but in *Anoplopoma* they are short. The scales are usually ctenoid (rough), but in *Ophiodon* they are cycloid. The scales in some species cover the entire body and head, but in others parts of the head are scaleless. *Chirus* has several lateral lines, but the other genera have but one. *Zaniolepis* and *Oxylebius* have three anal spines like the *Scorpænidæ*, and the latter would be a scorpænid were it not for the gill. *Anoplopoma* looks like a codfish or whiting and *Myriolepis* resembles a *Serranus*, or marine Percoid.

The family altogether is a refuge for a number of species that will not conveniently fit in anywhere else.

All the genera are confined to the North Pacific, and most of the species become more abundant northwards.

Myriolepis zonifer, Ln., is as yet known from a single example only, found in the market of San Francisco. The ctenoid scales cover body, head, and fins, except dorsal; and its general appearance much resembles that of a young Jew-fish, *Stereolepis gigas*. The coloration is black transverse bands on a whitish ground. *Oxylebius pictus*, Gill, may be known at sight by the six vertical cross bands on a yellow ground, barred fins, first dorsal of fifteen spines, anal with three, and especially by its elongated snout and small mouth. It is not very rare at Monterey, living among rocks in clear water near shore. From its small mouth and peculiar habits it is seldom taken except in dip-nets baited with crushed crabs. Its range extends northward beyond California.

Chirus pictus, Painted Sea Trout—This species is not at all common in the San Francisco market, but becomes more abundant in higher latitudes. It is often beautifully colored when fresh with blotches of bright green upon a dark brown ground. In alcohol these blotches become purple. In size, quality, and food it is identical with the next species.

Chirus decagrammus, Bodieron, Sea Trout, Boregat—It has always been supposed that *Chirus guttatus*, which is covered with yellow roundish spots upon a bluish gray ground, was perfectly distinct from *Chirus constellatus*, which has more or less perfect circlets of dark spots surrounding areas of a brighter blue than the rest of the body; but Professor Jordan has examined numerous specimens of both forms, and finds that all the *constellatus* are male, while all the *guttatus* are female. The two forms always occur together, and in about equal numbers, and the fishermen consider them identical. Professor Jordan believes that both names will have to give place to *Chirus decagrammus*, Pallas, which is probably the same species, as surmised long ago by Dr. A. Gunther. This species is everywhere moderately common from San Luis Obispo northward, especially in Monterey Bay. It is also common in San Francisco Bay, and abundant in the markets throughout the year. It feeds chiefly on crustacea and worms, and spawns in July. It is a tolerably good food fish, but inferior to the rock cod or green cod (*Ophiodon*).

It dies very soon after it is taken from the water, and the flesh softens very quickly. It reaches two or three pounds in weight.

A form with longitudinal series of yellowish blotches along the sides, once believed by me to be distinct, will probably prove to be only a variety of the female.

This form is described in the Proc. U. S. Nat. Mus. 1880, 55.

Anoplopoma fimbria, Candle Fish—This, though essentially a northern form, occurs along the coast as far south as Monterey. Until recently, it has been rare in the markets of San Francisco, but last year it was present in tolerable quantity, and during the present year (1880) may be almost called common. At Seattle it is very abundant, and is taken with hook and line from the wharves. At Monterey the Chinese take it with hook and line, while those caught outside San Francisco Bay are taken with sweep nets. It feeds on crustacea, worms, and small fishes, and reaches a length of twenty inches, and a weight of four to five pounds. This is not greatly esteemed as a food fish, but is sometimes fraudulently sold as Spanish mackerel.

Zaniolepis latipinnis, Long-finned Zany—As this fish has no vernacular title, and is not sufficiently common to acquire one from the fishermen, that given above is suggested. Though of no importance as a food fish, its singular appearance merits notice. In color, it is greenish-yellow, with blackish dots and bars upon the fins, and the surface of the skin is covered with prickles. These prickles are comb-like points radiating from scales that are buried in the skin. The first dorsal spine is long, the second longer, projecting far beyond the others, and often equal in length to half that of the fish. It does not exceed a foot in length.

Ophiodon elongatus, Buffalo Cod, Green Cod, Ln.—This has the reputation of being one of the most rapacious fishes of the coast. The various species of rock cod (*Scorpænidæ*) often come into the market mutilated, having lost a portion of the posterior part of the body. The dealers do not attribute this to the sharks, but to the green cod, which, they say, seldom or never takes the hook itself, but, darting out of its hiding place among the rocks in pursuit of the rock fish upon the hook, is caught and brought up along with it. It attains far larger dimensions than any of its brethren, among either the *Chiridæ* or *Scorpænidæ*, reaching a length of four feet. Its range extends along the greater part of the coast of California, but it is most abundant from Monterey northward. Professor Jordan states that it feeds on crustacea and squid, as well as upon other fishes; and that northward from San Francisco it attains a length of five to six feet, and a weight of from fifty to sixty pounds. The flesh is usually of a pale livid hue. On various parts of the coast it is taken with gill nets, as well as with hook and line. As a food fish it ranks high, and its size and abundance render it one of the most important species. Many are dried by the Chinese and Indians.

FAM. SCORPÆNIDÆ.

The species of rock cod or *Sebastichthys*, known previous to the present year, were eleven in number, and with *Sebastodes paucispinis* and *Scorpæna guttata*, made a total of thirteen *Scorpænidæ* peculiar to the coast of California.

To his own great surprise Professor Jordan has, during his stay here as Fish Commissioner, more than doubled this list; so that now twenty-five species of *Sebastichthys* are known to occur, besides one more northern form, making, with the other genera, a total of twenty-seven fishes belonging to this family on the coast of California.

Several of the forms described by Professor Jordan had been observed by the writer on previous occasions in the markets of San Francisco, but their resemblance to species already described was so great, the differences amounting often only to the greater or less development of certain spines upon the head, or to peculiarities of coloration, that, lacking the facilities for procuring an extended series, he did not venture to describe any of them as new, the more because the series of rock cod was already suspected by naturalists to be too long. But Professor Jordan, by an extended examination of numerous specimens of every species, of all ages and of both sexes, has proved that the characters which separate the various forms, slight though they may at first appear to be, are constant and thus of specific value. The spines upon the head, by their greater or less development, serration or by the addition of an extra pair; the gill-rakers; the form and height of the spinous dorsal; in a few cases the number of rays of the second dorsals and anal, and in all the species the pattern of the coloration are the characters relied upon to distinguish the species. The coloration is very constant in this group, so much so that a change in its pattern, or even in its color, is usually significant of a change of species. The twenty-five species of *Sebastichthys* all occur in the Bay of Monterey, and many of them at Santa Barbara. The Portuguese fishermen, who fish in deep water, give to the species they take distinctive names, and are perfectly well aware that they are different; but the Italians confound the shallow water species under one common title. The spines upon the top of the head are most developed in *S. nigrocinctus*, and in this respect *S. serriceps* comes next. Both are rare in the markets of San Francisco; the first the rarer, and both are black-banded. In the attempt to give his fish a descriptive name, Ayres called the former *nigrocinctus*, or black-banded, a name which applies better to the second species; while *serriceps* or sawhead would fit *nigrocinctus* even better than it fits the species to which it is applied. Ayres observed *serriceps* as long ago as 1859, for he remarks to this effect: "There is in the markets occasionally another fish of the *nigrocinctus* type which may eventually prove distinct." The spines or spinous ridges on the head of the fishes of this genus are an anterior pair upon the snout (nasals,) a posterior pair on the back of the head (occipitals,) and between these three pairs which, from their position, are called pre-ocular, supra-ocular, and tympanic. A pair of post-oculars, dismembered from the supra-oculars, is often present, and some have a pair of spines called "nuchal," behind the occipitals. In *nigrocinctus* the nuchal and tympanic pairs are wanting, but the others rise into high ridges with undulating or jagged edges. In *serriceps* the nuchal pair is present, and all the ridges end posteriorly in sharp spines rising well above the surface of the head.

S. nebulosus, *chrysomelas* and *carnatus* are a trio of fishes exceedingly similar in appearance, differing, in fact, only in coloration, and with only one or two specimens of each to look at, it is difficult to believe in their distinctness; yet, when one has seen lying, side by side, a hundred examples of *S. carnatus*, all exhibiting red spots in almost exactly the same positions of the yellow ones of *nebulosus*, and when one has seen a pile of *chrysomelas* with its characteristic broad yellow band from front of dorsal to tail, following nearly the same line as the principal spots of the *nebulosus*, and when this color difference has been correlated with certain differences in the form of the body and head, it is difficult to avoid the conclusion that we have here three distinct yet very closely related forms.

S. maliger and *S. vexillaris* may be known from all others by their very high spinous dorsal, with the membrane deeply emarginated between each spine, and from each other by the bright chrome yellow tint of the former.

In all the foregoing species the jaws are equal in length or nearly so, and the form of the body is short and thick; the greatest depth equal to or more than one third of the length of the fish. *Nigrocinctus* and *chrysomelas* are remarkable for the great width of the body at the origin of the dorsal, and for the abruptly shelving form of the nape and top of head. In the succeeding species the jaws are still nearly equal, but the body is more elongated. *S. rastrelliger* may at once be known by a glance at the gills, or rather at the gill-rakers, or comb-like teeth set upon the inner or throat side of the bones bearing the gills. In all the other species these are more or less elongate, but in this they are often broader than they are long. This is an exceedingly dark colored species, dark brown, clouded with still darker, and the dorsal fin is very low.

S. auriculatus, the common rock-fish of the bay, may be identified by the black spot upon the tip of the gill-cover; *S. rubrivinctus*, which rarely, if ever, comes to the markets of San Francisco, by the broad transverse stripes of red and yellow upon its body; and *S. ruber* by its deep uniform red tint, large size, and broad, flat preopercular spines.

S. auriculatus may also be known by the pair of small coronal spines near the median line of the skull.

S. constellatus and *S. rosaceus* have four or five light pink spots upon their dorsal outline, and the former is covered on back and flanks with small white spots. *S. chlorostictus* is similar to these in many respects, but may be known by the green spots scattered over its upper portions and dorsal fin, as well as by the greater height of the spinous part of the latter.

S. rhodochloris resembles *rosaceus*. *S. miniatus* is of a deep red tint, darker even than *ruber*, and is without the broad, flat preopercular spines which characterize that species. From *S. pinniger* it may be known by the rough scales which cover the entire head, even to the tip of the jaws.

S. pinniger, the *rosaceus* of Ayres, is usually more or less orange, with maroon blotches, and the fins, except the dorsal, are bright red. The scales on the head are not rough. Occasionally this species exhibits large blotches of black.

We started with species in which the spines were well developed, and have now reached those in which they are either present, but slightly developed, or are reduced in number. Moreover, in the remaining species the lower jaw protrudes beyond the upper, the protrusion increasing as we proceed.

S. elongatus has its greatest depth contained some four and a halr times in its total length, and the gill-rakers long, equal to more than half the diameter of the eye, which is very large. The interorbital space is slightly concave.

S. proriger is nearly as elongate as the last species, but the outline of the back is more rounded; the gill-rakers are longer, the eye smaller, and the forehead or interorbital space is slightly convex. In both species the body is irregularly banded with lighter and darker longitudinal bands, and the lateral line lies on a decided light streak.

S. ovalis may be readily distinguished from the two preceding by its much more ovate form, as well as by the almost uniform height of the dorsal, and its still more protruding lower jaw.

In *S. entomelas* the second anal spine is about equal in length to the third, the spines upon the head are very small, and hidden by the scales, and the peritonæum, or lining of the abdomen, is black, whence the specific name.

S. mystinus=*S. melanops*—Ay: is the most abundant species in the markets, and is generally distinguished by dealers as the Black Rock Cod. Its black color at once distinguishes it from all other species, the nearest to it in this respect being *S. ciliatus*, which, however, is spotted with black upon a gray ground. In *S. mystinus*, the top of the head is spineless, but there is a small tubercle in the place of the preorbital spine, which tubercle is absent in *S. ciliatus*, which is identical with *S. melanops*, Gir., and with *S. simulans*, Gill.

S. flavidus is greenish yellow, and might be called the Yellow Rock Cod, were it not for the brighter yellow of some portions of *maliger* and *rubrivinctus*. The projection of the lower jaw reaches its maximum in this species, its tip entering into the dorsal outline, and the gill-rakers are very long and slender, equal in length to three fourths of the diameter of the eye. In the three last species, the third anal spine is longest, and the anal rays eight in number. Small nasal spines are present.

Sebastodes paucipinis, Small scaled Rockfish, is placed in another genus on account of its small scales, straight back, and other peculiarities. The snout is almost twice as long as the diameter of the eye; there are nine anal rays, and the third anal spine is longest. A few economic particulars of these species may prove interesting:

S. nigrocinctus, the Black, or rather the Dark Brown banded Rock Cod, is found from Monterey to Puget Sound, and is tolerably abundant, in very deep water, in the Straits of Fuca. About San Francisco it is rare. It reaches a weight of four pounds.

S. serriceps, the Saw-head or Tree fish, is more southern in its range, but is abundant in rather deep water about Santa Catalina Island. The bands are decidedly black, instead of dark brown, as in *nigrocinctus*, and are more numerous than in that species. Northern specimens are larger, paler, and more brightly colored than southern. It reaches about three pounds, and is rare in the markets of San Francisco, though met with more frequently than the preceding.

S. carnatus, *S. nebulosus*, and *S. chrysomelas* are known to the fishermen by the name of Garrupa. The first is taken in great numbers with gill nets in rather shallow water, and is occasionally abundant in our markets. It is rare at Santa Barbara, and has not yet been noticed north of San Francisco. It reaches a weight of about two and a half pounds. It is classed with *atrovirens*, *flavidus*, *nebulosus*, and others, and is accounted a good food fish.

S. nebulosus is about equal in size and weight to the preceding, but is found in rather deeper water, and is scarcely so abundant.

S. chrysomelas, the Yellow-Banded Rock Cod, ranges from San Pedro to Puget Sound, and becomes more abundant northward. It occurs in water of moderate depth, and is taken with hook and gill nets. It reaches three and a half pounds.

S. maliger is found in rather deep water, and is commonest in the Straits of Fuca, where it is taken with hook and line. Occasionally it occurs in the San Francisco markets. It is larger than any of the preceding species, reaching a weight of six pounds.

S. rastrelliger, Garrupa, Dusky Rockfish, is not very rare in our markets, and reaches a weight about equal to that of the latter. About the Santa Barbara Islands it is taken with hook and line and with gill nets, rarely with seines. It is esteemed as food.

S. auriculatus, Wharf Rock-fish, is in individuals the most common of all the group in the San Francisco markets; and as it is plentiful in the bay, and is taken throughout the year, the total weight of the species brought in is probably about equal to that of *S. mystinus*, notwithstanding its smaller size. It is the only kind that frequents shallow bays, and is taken near shore from wharves and similar places, with hook and line. It reaches a weight of three pounds, but the greater part of those brought into the markets of San Francisco are young, and do not weigh more than half a pound.

S. vexillaris is the most variably colored and one of the most widely spread of the species, ranging from San Diego to Puget's Sound. It reaches a weight of five or six pounds, and is occasionally tolerably abundant in the markets of our city.

S. chlorostictus—Green-spotted Rockfish, the Pesce Vermiglia of the Italian fishermen, reaches a weight of four pounds, and is known only from Monterey Bay, where it occurs in considerable abundance along with the three following:

S. rhodochloris—Fly Fish, is only known from Monterey Bay. It is occasionally sent to San Francisco in considerable abundance in spring. It is not a large species.

S. rosaceus—Corsair. This is the smallest of the group, rarely exceeding one and a half pounds. It occurs among reefs in deep water, and where found is the most abundant of the red species. In San Francisco market it is abundant throughout the year.

S. constellatus—Bagre. This is another deep water southern species, taken with hook and line only. It is rather abundant, and of frequent occurrence in our markets. Together with the preceding small red species, it spawns at Monterey early in the spring. It reaches from two to three pounds.

S. rubrivinctus is appropriately styled the Spanish Flag by the Portuguese fishermen of Santa Barbara, on account of its gay red and yellow transverse bands. It occurs on reefs in very deep water, and is occasionally taken with hook and line in spring. It reaches a weight of six pounds.

S. ruber—Large Red Rockfish, Tambor, is probably the largest of all the species, reaching a weight of twelve pounds, or even more. It is graded upon the stalls with *pinniger* and *miniatus*, from which the dealers do not distinguish it. Its range extends to Puget's Sound, and its habitat is deep water, so that it is taken with hook and line. Professor Jordan, from whom all our additional knowledge of this group is derived, mentions that about Victoria the skulls of large specimens are infested with an encysted parasitic worm.

S. miniatus, Rasher, Rascira—Another deep water species, taken with hook and line, and also with gill nets, and occasionally sent to the city markets in considerable numbers. It is scarcely as large as *S. ruber*, but reaches eight or ten pounds, and is equally esteemed.

S. pinniger, Smooth Red Rock Fish, Hiaume. This is a deep water species, abundant everywhere from Monterey northward, and taken in great numbers, usually with set lines. It is probably the most abundant of all the red species in the San Francisco markets, and in size is inferior only to *S. ruber*, since it reaches a weight of from eight to ten pounds. It is esteemed as food, except when very large, when its flesh is rather coarse. Many are split and salted in the deep waters of Puget Sound.

S. atrovirens, Garrupa—Dark Greenish Rock Fish, abundant in rocky places in rather shallow water, and taken in great numbers in gill nets, south of Point Conception. Many are taken during Winter at the Santa Barbara Islands, and considerable numbers are salted and dried by the Chinamen. It reaches three pounds.

S. elongatus, Reina—Abundant with *S. proriger* in very deep water. Weighs about two pounds, and is not common in markets except in spring.

S. proriger rarely exceeds one and a half pounds in weight. Not rare in its haunts about Monterey Bay. In quality similar to other small red species.

S. ovalis, Viuda, Widow—A southern species, taken with hook and line in very deep water, and apparently somewhat rare. This species and *rubrivinctus* have not been observed in the San Francisco markets either by Professor Jordan or by myself, yet Ayres' type was procured there.

S. entomelas, Black-bellied Rock Fish—At present the least abundant of the group, and known only from Monterey Bay, where it is taken with hook and line in very deep water. This and the preceding are equal in size and value to the next.

S. flavidus, Yellow Tail—Not common in Puget Sound, but very abundant in Monterey Bay and about San Francisco. It occurs in both deep and shallow water, and is taken in large numbers both with gill nets and set lines. It is one of the largest of the group, reaching a weight of six to seven pounds, and is considered one of the best.

S. mystinus, Black Bass, Black Rock Cod, Black Garrupa, Pesce Pretre—More common about Monterey and San Francisco than either southward or northward of those points, and sent from Monterey and Tomales Bay to the San Francisco markets in greater quantity than any other, although from its dark color it is less salable than the more brightly tinted species. Large quantities are wasted, especially in autumn, when they fail to find purchasers at a cent per pound. It is found in rather shallow waters, is mostly taken in gill nets, and reaches a weight of five pounds.

S. ciliatus, Black-spotted Bass. This fish, in size, habits, and value, is similar to the preceding, and is by no means rare in the markets of San Francisco. It is most common in Puget Sound.

Sebastodes paucispinis, Boccaccio, Merou, Jack—The Italian "Boccaccio" or big mouth, fits this fish well. It is a large species, reaching a weight of from twelve to fourteen pounds, and a length of two feet eight inches. It is one of the best food fishes, and although not very common at San Francisco, becomes more abundant southward. The adults inhabit reefs in deep water, but the young come near shore in the Spring, and are taken from the wharves.

The rock fish generally live on small fish and crustacea. They spawn early in the spring, and some at least are viviparous. The young of the *S. flavidus* are extruded at a length of over one third of an inch, and the same is the case with *nebulosus*, *rosaceus*, *carnatus*, etc. Probably the whole group is viviparous. The first to notice this peculiarity was the Californian ichthyologist, Dr. W. O. Ayres, whose observations have in most cases stood the test of examination.

FAM. STROMATEIDÆ.

This family, a subdivision of the Scombridæ of Cuvier, is characterized by the presence of spinous processes from the vertebræ, forming teeth in the œsophagus, as well as by the absence of ventral fins. Only one species is known to occur upon our coast.

Stromateus simillimus, Pompino—This highly valued species occurs along the entire Pacific coast of the United States, having been seen in Puget Sound in the summer. It moves from place to place rather irregularly, appearing in schools at almost any season. It is but a small fish, rarely exceeding half a pound in weight, but its flesh is rich and fat, and its name helps to sell it, so that it readily fetches from twenty-five to fifty cents per pound. It is taken in seines, with hook and line, or by grabhook from the wharves.

A very curious monstrous example of this fish was brought to San Francisco market in the autumn of 1879. This individual was possessed of two mouths, externally alike, equal in size, and similar in structure; the lower mouth, situated somewhat behind the upper, directly beneath the eye, and in front of that bone of the gill cover which is denominated by naturalists the interoperculum, while the upper was in the usual position.

FAM. CARANGIDÆ.

Most of the species of this family, which is a subdivision of the old mackerel family (*Scombridæ*), that occur upon this coast, are widely spread and well known forms, and the presence of some of them was not suspected until Professor Jordan commenced his researches in the Spring of this year.

Trachynotus ovatus, a form more nearly allied to the New Orleans Pompino than is the fish which bears that name at San Francisco, was recorded by the writer as from Lower California in 1876, and probably extends as far north as San Diego.

T. pampanus, also found on the Atlantic coast of North America, occurs in Lower California, but has not yet been met with within the limits of our State. It may readily be known from *T. ovatus* by its more elongate body, accompanied by longer dorsal and anal fins, and by its darker color.

Trachurus saurus, the Horse Mackerel, is an old friend of the Levantines who carry on here the same occupations they pursue in the Mediterranean. Occasionally it strays up the coast as far north as San Francisco. It is taken in large numbers in seines, and salted for bait. It may be known from all other fishes found in the markets of San Francisco by the row of keeled plates along the center of the posterior part of the body for its entire length.

Caranx caballus may be known from the last species by the limitation of the keeled plates to the posterior portion of the body, as well as by a black patch upon the operculum.

Naucrates ductor, the Pilot-fish of authors—that small oceanic fish which is said to guide the shark to his prey—is said to occur south of Point Concepcion. It may readily be distinguished by the darker vertical bands across its bluish flanks.

Selene argentea is another species, found both in the Atlantic and Pacific, but at present not known to occur in the waters of our State, although, as it is common in Magdalena Bay, it is not improbable it may straggle farther northward. It is excessively compressed and thin, the top of the head almost vertical, so that it looks highly intellectual. The anterior rays of the dorsal and anal are very long.

Seriola lalandi—This is the well known Yellow-tail of the coasts of the tropics, and South America and Africa. At present, it is on record from this coast only from San Diego and the Coronados Islands northward to Santa Barbara, where it is abundant in the summer, spawning about July andAugust. In winter it is not seen. It is taken entirely by trolling, sometimes in considerable numbers, and as a fresh fish, ranks somewhat below the Barracuda. When dried, it is considered equal to the Barracuda, or to *Caulolatilus*.

It feeds upon squid and small fishes, and reaches a weight of fifty to sixty pounds, and a length of four to four and a half feet.

The curious Remoras, which have a sucking disk of large size occupying the whole of the upper side of the head and nape, constitute a small family, nearly related, in some respects, to the Carangidæ and Scombridæ, or mackerel family.

The sucking disk is a transformed spinous dorsal, and consists of a number (varying according to species) of transverse laminæ united to a central bar, and capable of being raised or closed like the slats of a set of blinds. By means of this sucker, the Remora attaches itself to a shark, a ship, or other floating object, and allows itself to be carried wherever its host pleases, thus economizing labor. An example of *Remora jacobæa*, which has seventeen to nineteen laminæ in its disk, was last year taken in the Bay of San Francisco from the body of a shark, which it had accompanied in its wanderings. The larger *Echeneis naucrates* has also occurred at San Francisco.

FAM. SCOMBRIDÆ.

All the true Scombridæ have a greater or less number of finlets behind the soft dorsal and soft anal, each finlet consisting of a single ray followed by a membrane of triangular shape.

There is little to separate them from the *Carangidæ*, except the non-protractile mouth; and one genus bridges over this difference. All are oceanic and swim in large schools.

Scomber pneumatophorus, Spanish Mackerel—This species is known also as Easter Mackerel, and Little Mackerel, and occurs from Monterey Bay southward, coming up in irregular and often large schools in summer and fall. It is occasionally sent to the markets of San Francisco. It does not exceed fourteen inches in length.

Scomber scombrus, Mackerel—There is little doubt of the occurrence of this fish upon the southern part of the California coast, although Professor Jordan did not see it. Captain Charles Willughby, Indian Agent at Neah Bay, and formerly a Massachusetts mackerel fisher, gave information that he once netted a school of Eastern mackerel off Catalina Island; and a fisherman at Santa Barbara claimed to have taken it off Anacapa Island.

Scomberomorus concolor—This species is here called the Spanish Mackerel, is very rare, is held in high repute, and fetches a high price. It may be known by its slim form, and toothless palate. This is the *Chriomitra concolor* of my previous report. The nearest of kin to this fish is the *Cybium maculatus* of the Atlantic Coast.

La Cepedes's name *Scomberomorus* has precedence of *Cybium*, and as *S. maculatus* has the palate toothless, our Spanish Mackerel must be included in the same genus. Minute papillæ upon palate and other parts of the internal surface of mouth and gill-cavity are possessed by both species, but the only true teeth are those in the jaws.

Sarda chilensis, Bonito, Skip-jack—This is not identical with the European bonito, although it belongs to the same genus. It was first described from Chili, and is known to occur along our coast as far north as Monterey Bay. In the summer it is very abundant, and is taken in great numbers by trolling, especially about Santa Barbara and San Diego. Many are salted and dried, but the flesh is rather coarse, and is considered inferior to the Barracuda and Yellow-tail. Some persons aver that it makes them sick. It reaches an average weight of about twelve pounds, and sells at about twenty-five cents in the localities where it is taken. About August it becomes abundant in the markets of San Francisco, so much so, that it frequently cannot be sold while fresh.

Orcynus alalonga, Albicore—This is one of those widely spread species which confound the best efforts of naturalists who have not had abundant opportunity for comparison. As *Thynnus pacificus*, this species was described by Cuvier, and Valenciennes, and again, under the name of *Orcynus pacificus*, by Cooper in 1863 (Proc. Acad. Nat. Sci. III, 75), but Professor Jordan considers, from examination of fresh specimens, that it is identical with the well known *Thynnus* (*Orcynus*) *alalonga* of the Mediterranean and Atlantic, the alalonga or long-wing of the Italians. There is no mistaking the fish for any other found upon our coast. Its long pectoral fin, reaching a considerable distance beyond the second dorsal fin, is a distinctive mark which none can overlook. The first dorsal is long, and has fourteen spines, while the second, of twelve soft rays, is followed by eight finlets, or separate rays, each with a membrane attached. The anal has eight separate finlets. In color it is steel blue upon the sides, becoming blackish above, and silvery white below.

It occurs in the Bay of Monterey in the later months of summer; is brought occasionally to San Francisco market, and becomes abundant farther southward, notably among the islands of the Santa Barbara channel. It affords excellent sport, being caught by trolling while sailing very rapidly, and biting voraciously at a white rag. Those brought to the markets of San Francisco were caught from the deck of a vessel.

It frequents deeper water than the bonito, and in Santa Barbara channel is rarely taken within six miles of the shore.

Like the bonito, it feeds chiefly on anchovy and squid, but is occasionally taken with rare deep water fishes in its stomach.

It reaches greater weight, is comparatively deeper in form than the bonito, and is less valued even than that fish.

Another species of *Orcynus*, probably *O. pelamys*, also a Mediterranean species, is known to occur on our coast; and a *dolphin* (*Coryphæna*) species unknown, is known from an individual once washed ashore at Cayucos Landing.

FAM. LABRIDÆ.

The Labridæ, or Wrasse family, a numerous tribe of fishes, is but poorly represented upon the coast of California, where its place is to a great extent filled by the Embiotocidæ, or viviparous perch. The Labridæ have a single dorsal, the spinous portion of which is at least as much developed as the soft, and are covered with cycloid scales of moderate or large size. The lips, as the name indicates, are largely developed, and the mouth is capable of great protraction, the length of the ascending processes of the intermaxillaries, or upper jaw bones, permitting much forward movement.

Many of the fishes of this family are beautifully colored, and most of them attain dimensions that render them valuable as food fishes.

The Labridæ live largely upon mollusks, and some are more or less herbivorous.

Pimelometopon pulcher, first described by Dr. W. O. Ayres, under the more pronouncable name of *Labrus pulcher*, is, as its name implies, a highly colored fish. Its chief adornment consists of a bright red band extending across the body from the head to a perpendicular from the anus, contrasting strongly with the black head and hinder portions of the body. This is one of those species which prove that it will not do to attach too much importance to comparative proportions of depth to length, since the depth and thickness of the front portion of the body increases with age so much, that one of those mathematical naturalists who seek to bind nature to fixed rules might make several species out of it. It attains a length of two feet or more, and a weight of from twelve to fifteen pounds. It is very abundant in the kelp south of Point Concepcion, and is taken in immense numbers by the Chinese, who dry and salt it.

The flesh is rather coarse, but the fat forehead is esteemed for chowder. It feeds upon crustacea and mollusks. Rare instances of its occurrence at Monterey are on record.

Platyglossus modestus, King-fish—This species shares with several others, in no wise related to it, the names of king-fish and sea-trout. It is rarely brought to the markets of San Francisco, yet it is of common occurrence in the Bay of Monterey, and from that point southward. It is a shallow water species, and frequents the kelp that floats near the shore, and is taken from the wharf at Monterey in dip nets.

When fresh, the adults are far from deserving the name of *modestus*, since they are decorated with waving, broken lines of bright green upon the sides of the head, are bright orange red below, becoming brown above, and have the front edge of each scale marked with a line of green. The first dorsal is bright blue at the base; there is a dark green or blue spot at the upper pectoral axil, and a black blotch on the base of the tail-fin.

The young are much less brightly tinted, the green lines are not conspicuous, and the color is olivaceous above, fading into whitish below. It is common in the kelp, and is often taken with hook and line, or with baited dip net. It is chiefly used for bait, although its flesh is said to be of good quality.

Platyglossus semicinctus, the Kelp Fish, is not rare in the kelp from Santa Catalina southward, and at San Pedro is occasionally taken in gill nets and sometimes with the hook. It is larger than the last species, reaching about a pound in weight.

FAM. POMACENTRIDÆ.

Of this family, which includes numerous short-bodied, large-scaled fishes with the lower pharyngeal bones united, only three species are know to occur upon our coast, and neither of these ranges north of Point Concepcion.

Hypsipops rubricundus, Garibaldi, Red Perch—This species is abundant at the Santa Barbara Islands and southwards; is taken chiefly with gill nets; reaches a weight of three or four pounds, and is not held in high esteem as food.

Chromis punctipinnis, known as the Blacksmith, is abundant in the same localities as the last, and is taken with gill nets, or with hook and line. It reaches two pounds in weight, but is not valued. Like the other species of the tribe, it feeds on shell fish and crustacea.

FAM. EMBIOTOCIDÆ.

This curious tribe of viviparous fishes has had its numbers increased by the addition of three species, described by Messrs. Jordan and Gilbert, and all occurring in the markets of San Francisco.

One of these, *Ditrema atripes*, is exceedingly like the better known *Ditrema* (*Phanerodon*) *furcatum*, but is larger, and may be distinguished by the darker tint of the sides, becoming still darker on the back, where the ground color is interspersed with small streaks of dard red; as well as by the black-tipped ventrals. This species is occasionally sent to market in considerable numbers from Monterey, where it is taken in seines.

Brachyistius rosaceus is a pretty little pinkish fish, with two darker spots on each side near the base of the soft dorsal.

The first specimen observed in the market was treasured by the dealer as a curiosity, and the second was secured by the writer for Professor Jordan, who has since obtained two or three others. It is rare, and at present only known from the markets of San Francisco.

Abeona aurora is, from the structure of the teeth, nearly related to the Least Shiner, (*Abeona minima*) but does not very closely resemble it, in general appearance, and is larger. It may be identified by the brassy streak which extends along the body from the snout to the base of the caudal, and by the blackish axil of the pectoral, and the considerably forked tail fin. At present it is certainly known only from Monterey Bay, where it is very abundant about rocks. Many inhabit the larger rock pools at Point Pinos. It reaches about a third of a pound in weight.

Some alterations have been made in the nomenclature of this group. The short, broad species, called by Gibbons' *Hyperprosopon* have, together with *Hypercritichthys* of Gill, been placed by Professor Jordan in *Holconotus*, (Agassiz) from which they are not distinguished by any structural character; and for similar reasons the genera *Phanerodon* of Girard and *Tæniotoca* of Agassiz have been merged in *Embiotoca*, which must itself give way for the older name of *Ditrema*, since the species which of all the group was first described, namely, *Ditrema temmincki*, a Japanese fish, turns out to be, according to Professor Jordan, generically identical with *Embiotoca* of our own coast.

As food fishes, the Embiotocidæ are far inferior to the other leading groups of the coast, but their abundance in species and in individuals renders them valuable. All the tribe feed upon crustacea and small fishes.

The great peculiarity of this tribe does not consist so much in the mere fact that the eggs are hatched within the body of the mother, since this occurs also in the large group of rock cod; but in the small number and high state of development of the young, and in the modifications of structure of males and females, resulting in an evident differentiation of the sexes. The eggs are hatched, and afterwards the young develop, within the ovaries, which are developed for the purpose into a number of pouches or rather folds, and from which they escape into the sea through the vulva. There is no trace of any connection of any kind between the young and their parent; no rudimentary placenta, as there is in some sharks. The males have the anal fin constructed differently to that of the females, and it is probable that some sort of copulation takes place, as the eggs must be fecundated while within the ovary. The hard structure in the anal fin of the male is a clasping organ.

In most genera there is between the ventral fins and the anal an elongated naked area, forming a groove, and between the basis of the ventrals is a lance-shaped blade, covered with scales, its free tip overhanging the front of the scaleless area.

From Professor Jordan's notes I glean the following fresh particulars respecting the previously known species, which were treated of more fully in the report for 1879.

Rhacochilus toxotes, is known to the fishermen as the Alfione, bring forth from fifteen to twenty young in summer, and is considered the best of the group.

Damalichthys argyrosomus, ranges northward to Puget Sound, where it is exceedingly abundant; is probably of all the species the third most numerous in individuals, and in quantity ranks next to the preceding. It is called White Perch.

Ditrema furcatum (*Phanerodon furcatus*, Gir.) lives in sheltered bays and is taken in seines in great numbers; is very abundant from San Francisco southward, but has not been noticed north.

Ditrema laterale, Surf Fish, Blue Perch—This species is very abundant north of our State, reaching to Puget Sound, and is on the whole, the most common of the large species.

Ditrema jacksoni, the Black Perch, Pogy, or Black Bass, belongs especially to California, but extends to Puget Sound.

Hypsurus caryi, Bugara—This fish is usually very abundant at the edge of the kelp, especially at Monterey, where it is often taken with hook and line, or in baited dip nets, and sometimes in great numbers in seines. It is used chiefly for bait for rock cod; but the larger ones are sent to market.

Amphistichus argenteus, Silver Surf-fish—called by the fishermen Surf-fish and White Perch, is, on some sandy shores, very abundant, especially in the surf. At Santa Barbara and Soquel, it is more common than elsewhere.

Holconotus rhodoterus, which may be called the Red-finned Perch, is not so common as most of the others, except in certain localities, one of which is Soquel. It reaches about a pound and a half in weight.

Holconotus agassizii (*Hyperprosopon agassizii*) is, like the preceding, known to range from Tomales to Santa Barbara, and is small, rarely weighing over half a pound.

Holconotus (*Hyperprosopon*) *argenteus*, Wall-eye or Silver Perch—is everywhere abundant, and is taken in great numbers in seines on sandy shores, as well as with hook and line from wharves. It is not much esteemed as food, and is small—usually weighing about half a pound.

Holconotus analis. Only locally abundant; common at Santa Cruz and Soquel, where large quantities are taken, along with the Shiner (*Cymatogaster aggregatus*), as bait for rockfish. As it does not weigh more than a quarter of a pound, it is seldom brought to market.

Brachyistius frenatus. Widely distributed, and at some localities, as at Monterey, Point Reyes, etc., very abundant; but used chiefly for bait, on account of its small size (quarter pound), and not sent to market, unless accidentally mixed with other species. Ranges to Puget Sound.

Cymatogaster aggregatus, Shiner, Sparada, Minnie, Little Perch—This is, everywhere, from San Diego to Puget Sound, the most abundant of the group, and is found especially in sheltered bays. It is about equal in size to the last.

Abeona minima, Shiner—The smallest of the tribe.

Most of these species occur in the Bay of San Francisco, and all that weigh half a pound or over are sent to market. The most important, as regards the weight actually sold, are *Dit. jacksoni*, *D.*

laterale, *D. furcatum*, *Rhacochilus toxotes*, *Damalichthys argyrosoma*, *Amphistichus argenteus*, and *Holconotus argenteus*. In the spring (April and May), *Hypsurus caryi*, the Orange-banded Perch or Bugara, is common. The Red-finned Perch is not often in the market.

The Silver Surf-fish (*Amph. argenteus*) was, during last Winter, sent in great numbers from Monterey, and many individuals approached the Alfione, or Thick-lipped Perch, in size and weight, reaching a length of fourteen to sixteen inches, and a weight of four or five pounds.

Professor Jordan does not believe *Hyperprosopon arcuatus* to be a valid species; so that all the large-eyed, up-turned mouth and short-bodied perch, are to be considered as one species, and the name Wall-eye will suit very well.

Hysterocarpus traski, the only member of the family that inhabits fresh water, has been frequently sent to market during the summer, notwithstanding its small size. It occurs in streams at least as far south as San Luis Obispo.

FAM. SCIÆNIDÆ.

The family of sciænoids is not largely represented on the northern portion of our coast, but its members become more numerous from Point Concepcion southwards. Into the Bay of San Francisco come *Cynoscion nobilis*, the sea bass; *Genyonemus lineatus*, popularly called king-fish, and *Seriphus politus*, also called king-fish. The last is far from common, but the first two are well known and highly prized food fishes. The first attains a large size, examples of from forty to sixty pounds weight being frequently brought to San Francisco market in summer months.

The king-fish rarely exceeds ten inches in length, but makes up for its small size in its delicate flavor.

Below Point Concepcion occur *Corvina saturna*, *Roncador stearnsii*, *Umbrina xanti*, *Cynoscion parvipinnis*, and *Menticirrus undulatus*, making a total of eight species.

Cynoscion parvipinnis, Blue-fish, Corvina, also called Caravina, and Sea Bass—This species, originally described by Dr. W. O. Ayres, occurs at San Pedro and southward, and is not rare in winter, when it frequents the bays and is taken in seines and gill nets. It feeds chiefly on crustacea. Its flesh is esteemed, but will not keep long, reeembling in this respect the weak-fish—(*Otolithus regalis*)—of the Atlantic States. It reaches a length of two feet, and a weight of five pounds, (Jordan).

Cynoscion nobilis (*Atractoscion nobilis*), Sea Bass, White Sea Bass—Very abundant in spring and summer from San Francisco southward. It feeds on crustacea, anchovies, etc. The young are sold as sea trout, and are often considered by fishermen a distint species. This is one of the most valued food fishes of the coast, having firm white flesh. Examples of from fifty to sixty pounds weight are not rare in our markets.

Menticirrus undulatus, Sucker Bass, also known as Bagre and Sucker—Abundant from Santa Barbara southward, on sandy shores, and taken in seines and gill nets. It feeds largely on crustacea, reaches a length of eighteen inches, and a weight of two pounds and a half, and is held in moderate esteem as food. (Jordan).

Umbrina xanti, Yellow-finned or Yellow-tailed Roncador—This species is abundant from Santa Barbara southward, on sandy shores; feeds on crustacea, squid, etc., and spawns in July. It reaches about a foot in length and two pounds in weight. Many are taken in seines and gill nets. It is considered a food fish of good quality, and at San Pedro many are split and salted.

Genyonemus lineatus, King-fish, Little Bass, Little Roncador—This species ranges southward at least to San Pedro, but is most abundant northward, especially in summer, becoming scarce in winter. It lives between the shore and the kelp, and is taken with hook and line at the border of the kelp, as well as in great numbers in seines. Crustacea form its principal food. Many are dried by the Chinese. The flesh is rather soft.

Roncador stearnsii, Croaker, Roncador—Abuudant from Santa Barbara southward, on sandy shores, in rather deeper water than *Umbrina xanti*, and taken chiefly in gill nets. It feeds mostly on crustacea, spawns in July, and reaches a length of two feet, and a weight of five or six pounds. It is considered a good food fish.

Corvina saturna, Black Roncador—This fish has the same range and occurs in similar situations with the preceding, but is less abundant, and smaller, not exceeding eighteen inches in length, and about three pounds in weight. It is less attractive in color than *Umbrina* and *Roncador*. This species may be recognized by its dark gray color, bluff snout, and short body.

Seriphus politus, King-fish, Queen-fish—Rare at San Francisco, but more abundant southward, along sandy shores. It is taken in seines, especially at Santa Barbara and Soquel. Although in flavor probably the best of the small *Sciænoids*, its small size—seldom more than eight inches—causes it to be but little valued.

FAM. PERCIDÆ—PERCH.

This family has been divided and subdivided into numerous groups, and it now appears likely a reunion may be established. The *Sparidæ*, which have the hinder end of the maxillary hidden behind the suborbital in the closed mouth, and are furnished either with cutting incisors in front of the jaws, or grinding molers at the side, seem at first very distinct, but they are linked by such forms as the *Pristipomatidæ* with the more typical *Percoids*. As only nine species are yet known upon our coast, it will be as well to consider them all as *Percidæ*.

Girella nigricans, Blue-fish—This appears to be the only sparoid fish found on the coast of Upper California. It occurs but rarely in the markets of San Francisco, where it is brought from the Bay of Monterey. Its proper range ends near Point Concepcion, northward of which those found are only stragglers, while southward it is abundant.

It may be recognized by its curious three pointed, or rather three lobed teeth. In form it is an elongated oval, and in color an almost uniform brackish olive. It is abundant about Santa Barbara, where it is usually taken in gill nets, and is an important food fish.

It is entirely herbivorous in its habits, and is very tenacious of life. Soon after death the flesh begins to soften. It reaches a length of about a foot, and a weight of four pounds.

Scorpis californiensis, Moon-fish—Exceedingly rare, though this species is at San Francisco, it becomes abundant south of Point Concepcion, so much so that the great bulk of the fish taken by the Wilmington fishermen off Santa Catalina Island, for the supply of Los Angeles, consists, Professor Jordan informs me, of this fish. The few that have been taken in Monterey and even in Tomales bays must be regarded only as stragglers from the crowd. Its chief food is crustacea. It reaches about a foot in length and three pounds in weight, and ranks high as a pan fish.

In color it is gray, the ventral fins are covered with scales, the form is a regular oval and the mouth is small, with three lobed incisors.

Serranus maculofasciatus, Rock Bass—Abundant in bays from Point Concepcion southward, especially at San Diego, where it is taken in seines and also with hook and line from the wharves. It is not found in deep water nor about islands. It feeds chiefly on crustacea and squid; reaches a length of fifteen inches and a weight of from two to three pounds, and is considered an excellent food fish.

This species is prettily spotted all over with small round purple spots, and across the body, overlying the spots, run several irregular darker transverse bands.

Serranus nebulifer, Johnny Verde—The greenish tint of this species explains its common name, but the lower part of the head exhibits purple spots similar to those of the last species, to which, despite its more elevated dorsal, it is closely related. It ranges to Monterey, and is common in San Pedro and San Diego Bays. A large example reaches twenty inches in length, and a weight of about four pounds. It is considered a good food fish.

Serranus clathratus, Cabrilla, Rock Bass, Kelp Salmon—From Monterey southward, becoming more abundant towards the southern extremity of the State, and constituting one of the most important food fishes of the Santa Barbara Islands. It lives among rocks in not very deep water; feeds on crustacea and squid, and reaches about the same size as the last species. It is considered one of the better class of food fish, and is only occasionally split and salted.

Stereolepis gigas, Jew-fish, Black Sea Bass—The Farallones appear to be the northern limit of the range of this huge sea-perch, which becomes abundant southward, especially about the Santa Barbara Islands. It is said to be an excellent food fish, but from its great size, is not often taken. It is caught by still-fishing, not by trolling, but individuals are often taken by swallowing white-fish, etc., when the latter are on the hook. Small examples are sometimes brought to San Francisco market, and its occurrence within the Bay of San Francisco is on record. It reaches a weight of four to five hundred pounds.

FAM. AMMODYTIDÆ—SAND LANCES.

Ammodytes personatus, the sole member of this family recorded from this coast, is abundant upon sandy shores from Monterey northward. In Puget Sound it is exceedingly abundant, swimming about bays close to shore in immense schools. Sometimes it is found buried in sand between tide marks. It reaches a length of five or six inches and is seldom eaten.

The *Ammodytidæ* have no ventral fins; the gill membranes are continuous around the throat, and the vent is situated far back upon the body. In the Aleutian Islands this fish is called the Candle fish.

FAM. SPHYRÆNIDÆ—BARRACUDAS.

This small family of highly carniverous and swift swimming fishes contains the genus *Sphyræna* only, and is represented on this coast by *S. argentea*, the well known Barracuda of our markets. From San Francisco southward it is abundant in summer, when it probably comes near shore for the purpose of spawning. Its chief run is in July. In the winter it probably retires to deeper water. Professor Jordan states that it is taken chiefly by trolling at a distance of three or four miles from shore, except about the Santa Barbara Islands, where it is taken with hook and line. In autumn and winter the young are sometimes taken in seines. It is considered one of the best food fishes, and and when salted and dried, sells at a higher price than Alaska codfish. It reaches a length of three or more feet, and a weight of twelve pounds. The Sphyrænidæ are covered with smooth scales, and have the ventrals placed far back.

FAM. ATHERINIDÆ—FALSE SMELTS.

Three species of this family, which, though containing chiefly small fishes with feeble teeth, agrees with the last in having smooth scales, and in the abdominal position of the ventrals, are found upon this coast.

Atherinopsis californiensis, the Common Smelt, is taken in great numbers in all bays open to the ocean from San Francisco southward. It resides in positions sheltered by rocks, and is often caught by trolling with a small hook.

Atherinops affinis, the Little Smelt, prefers, according to Professor Jordan, more sheltered situations than the former for a residence. It is considered a pan fish of good quality, having firm but rather dry white flesh. Though smaller than *A. californiensis*, it reaches a foot in length. Many are dried by the Chinese.

Leuresthes tenuis—This occurs in large schools at San Diego, and reaches a length of five inches.

FAM. MUGILIDÆ—MULLETS.

The Mullet, mentioned in the last report of the Fish Commissioners, proves to be really *Mugil mexicanus*. In San Diego Bay, Professor Jordan found it abundant. At San Pedro it made its appearance three years ago, and has since been tolerably common, and it is occasionally sent to our markets from Monterey. Professor Jordan believes that it is spreading northward along the coast. It feeds upon mud containing organic matter, reaches a length of about fifteen inches and is much esteemed as a pan fish.

In winter, it enters creeks and lagoons, where many are landlocked and destroyed by sea birds.

FAM. SCOMBERESOCIDÆ—GAR-FISHES.

This group of fishes is represented on the southern part of our coast by four species. From all otherwise related families these may be known, by the union of the lower pharyngeal bones into a single bone (as in the *Labridæ*), and by the presence of a series of keeled scales along each side of the belly.

As in the Cyprinodonts, there is no adipose dorsal fin, and the dorsal and anal are placed far back upon the caudal part of the body.

Belone exilis—Needle-fish, Gar-fish. In summer, this species frequents bays and lagoons along the coast from Santa Barbara southward, for the purpose of spawning, but it is not common. It reaches a length of two and a half feet, and is esteemed as food.

Exocœtus californicus, Flying-fish, Volador—Professor Jordan has found this species abundant along the southern part of our coast, as far north as Santa Cruz. It is particularly common in Santa Barbara Channel, and about Santa Catalina Island. It goes in great schools. Respecting its habits, the following is quoted from the MS. of Professor Jordan:

"The Flying-fish flies for a quarter of a mile, not rising more than three or four feet above the surface. Its motive power is given by rapid movements of its powerful tail in the water, which movements are continued after the body is out of the water and the pectorals spread. When the tail is out of the water, the ventral fins are also spread out, and the motions of the pectorals cease. Its motion is then very swift, and in a straight line, which afterwards becomes a curve by the partial turning over of the body, one wing being placed partly against the wind. Motion is often renewed by putting the tail once more in the water, as the fish falls so as to touch it. It is to some extent able to shy off from a vessel. In the water its movements are very rapid. It reaches a length of fifteen inches and a weight of a pound and a half or more, and is considered excellent food. It spawns about the beginning of August, which is the cause of its visit to the coast. Large numbers are taken in seines and gill nets off Catalina Island. Nine-tenths of those seen in July were males."

FAM. SALMONIDÆ—SALMON AND TROUT.

The salmon and trout, once reported to be so numerous in species, are gradually becoming fewer as examination is made of the same species at different seasons of the year, in salt and fresh water, and at the various periods of its life.

The long list of anadromous salmon (*Oncorhynchus*) is now by the researches of Professor Jordan and Mr. Gilbert, reduced to six, which bear the provisional names of *nerka*, *gorbuscha*, *quinnat*, *kisutch*, *keta*, and *kennerlyi*.

These names are provisional because some, if not all, of the species not only occur upon the Pacific Coast, U. S. A., but extend northwards to Behring's Straits, and down the opposite coast of Kamtschatka. They are thus probably identical with some or other of the species previously described from the coast of Asia.

The various species of salmon and trout are subject to great variations in consequence of change of habit, as well as to others caused by age, sex, and season; and these changes have been the cause of the excessive multiplication of nominal species. Salmon, when in the sea, are of a silvery, steely, or bluish tint, darkest upon the back. When in the river, the silvery tint is lost and the flesh also becomes lighter. The young of all the species are cross-barred with darker tints which disappear with age. The form and proportions of the body are also, in the anadromous species, liable to change, as also those of the fins. Neither can comparative size be depended upon.

The *Salmo sebago* of the lakes of Maine is believed to be only a landlocked *Salmo salar* depauperated by the more confined habitat. The trout of a small brook never attain the size of those of a larger river.

The *quinnat* of this coast was prevented from returning to the ocean from the lakes San Andreas and Pilarcitos by the erection of the dams of the Spring Valley Water Company, and now those lakes are full of salmon which mature their eggs and milt when less than a pound in weight.

The characters which can be depended on to distinguish the species of salmon are as follows: To some extent, the form of the caudal fin and the arrangement of the spots upon the body, especially near the tail; the number of rays in the anal fin (*Oncorynchus* has fourteen or more, *Salar* or *Salmo* about twelve); the size of the scales; the number and size of the gill rakers, or toothlike processes upon the bones which bear the gills; the number of branchiostegal rays; and the number of the pyloric cæca which are attached to the lower end of the stomach. The teeth are also to be regarded, but not implicitly, as they are liable to alterations with age. More attention has naturally been devoted to the study of this group than to that of any other, on account of its importance as a source of food.

Upon this coast, the salmon fishery upon the Columbia alone accounts for about a million and a half of salmon, weighing when taken at least twenty-five pounds each on an average. This is probably equal to twice the total weight of all other fisheries, salmon included, carried on upon the Pacific Coast of the United States, even with the Alaska cod fishery thrown in.

The life history of these fishes is thus invested with much interest, since, upon our knowledge of it, depends the success of any attempt that may be made to prevent, by judicious legislation, the threatened decrease of the species.

The season of the principal run differs according to the species, and it appears to be tolerably well established, by the reappearance of marked fish, that some individuals make good their retreat after spawning, and return again next year, although the greater portion die of the exhaustion consequent upon their ascent of the streams. This is the case more particularly with those which ascend highest, jumping falls, passing rapids, and braving the difficulties of a long journey without food.

Oncorhynchus quinnat, the Common Salmon—This is the salmon *par excellence* of the Pacific Coast, the victim of the canning industry, the Columbia River salmon, the taste of which is familiar to Briton, Australian, Frenchman, and Teuton. As the salmon business is fully discussed in the Report of the Fish Commissioners, no statistics need be given here. An interesting fact in its natural history is that, as with the shad, so with the *quinnat*, we know where some at least of the individuals spend their time while absent from our rivers. In this respect we are ahead of our Atlantic brethren, who, as yet, have not found out what *Salmo salar* or *Clupea sapidissima* do with themselves during their holidays. *Quinnat*, like *Clupea sapidissima*, and all the rest of our fashionable society, recreates in the Bay of Monterey, where he has this year furnished much amusement and some food.

It appears singular that few *quinnat* were caught during summer in the above named bay until this year, and this may appear to suggest a change of habit in the fish; but, in view of the fact that new species of fish and crustacea are continually being brought in, and that this is known to be caused by the search of the fishermen in new fishing grounds, it is more probable that the *quinnat* have always been there, but that the fishers have failed to find them until lately. But it must not be supposed that all the *quinnat* go to the Bay of Monterey. Examples have been taken far southward of this point, and a few run up Ventura River every year.

South of this river our coast does not present any streams running freely into the sea, as the rivulets terminate in lagoons separated from the ocean by sand bars. The *quinnat* has evidently the most southern range of any of the species of *Oncorhynchus*, and possibly becomes less abundant northward, the most abundant salmon of Fraser River being *O. nerka*, the blue-back of the fishermen. Yet it is thought that the large "King-salmon" of Alaska is this species.

Notwithstanding the study that has been given to the habits of salmon, there are yet many points in their life history which are not cleared up. They are hatched in clear running brooks accessible from the ocean; they run down to the ocean when three or four inches long, and they return to the rivers to spawn. This much is certain, and it is certain also that the greater portion of the returning fish are large, and of the age of about four years. As smaller individuals, containing spawn, are sometimes taken, it is not unlikely that some run up the river and spawn once or twice before their final and fatal journey. However this may be, it appears that when full-grown, the salmon approach the coast, where, meeting with currents of fresh water from the rivers, they become irresistibly attracted, and follow them up until fairly within the stream. When at sea they feed freely and bite vigorously at a hook, but as soon as they are fairly within a river, they cease to feed and cannot be tempted to bite. The proof that they do not eat lies in the fact that the stomach of those taken in the river is always empty. Once in the river, they become impressed with an irresistible desire to penetrate further and further, and in obedience to this impulse, they mount rapids, spring up small cataracts, and flounder through shallows until, spent with exhaustion, battered and wounded by contact with rocks and other obstacles, and still further worn out by the process of spawning, the greater portion die. All spawn before they die, and as the strength of the individuals differs, they spawn at various points all along the river and its tributaries, but always in comparatively shallow and clean water. In spawning, they pair off; the female deposits her spawn upon the gravel, and the male pours out upon it the fertilizing milt. As the males mount up the river, a great change takes place in the form of the head. The jaws commence to enlarge and to curve, the upper forming a hook directed downwards, the lower a similar hook directed upwards. Coincident with the growth of the jaws, is that of the group of teeth upon their lips, which become relatively immense. The result is a "dog salmon" with a physiognomy utterly unlike the straight-jawed, neat looking individuals just arrived from the sea, and it is no wonder that such old males have been described as distinct species. The males also develop a more or less conspicuous hump upon the shoulder, but this is not very evident in the species we are now considering.

The females do not, at least as a rule, develop the hooked jaw, although it is reported that some individuals with hooked jaws have been found to contain ova. Dead salmon are often found in the shallows of the upper courses of the rivers, having died before they could reach deeper water.

Some adventurous individuals follow the Columbia into the Territory of Montana before they succumb.

The color of the flesh of a salmon does not indicate its species, since the same individual which had bright red flesh when in the ocean, and at the commencement of its run, will become nearly white at or after spawning. It is clear from what has been said that the flesh of the "kelts," as the salmon after spawning are called in England, can scarcely be fit for consumption by human beings. Covered with wounds upon which fungus spores find a suitable nidus, many look sufficiently repulsive. It is probable that the stories of so called "poisonous" fish and other marine animals arise entirely from the injudicious eating of such creatures when exhausted with spawning, or when afflicted with some disease, the outward symptoms of which we do not recognize.

In the smaller rivers of the coast the run of salmon takes place in the autumn, thus, in Eel River, it commences when the first rains have caused the waters to rise. Thus the canning season upon the Coquille, Eel, and other small rivers, commences after that of the Columbia River is over. Some *quinnat* run up the Columbia in the autumn, and it is to this fact that we owe the preservation of the species, in spite of the immense numbers taken. The fishing is carried on during the spring run only, from April to July, during which season some 1,500 boats are perpetually engaged in it, so that from the bar up to off Mount Ranier there is an almost continuous web of nets, effectually preventing the ascent of by far the greater portion of the fish. Professor Jordan is, however, of opinion that the autumn run is sufficient to counterbalance the destruction. In Klamath, Fraser, Sacramento, and Rogue Rivers there is also a spring run. An ordinary full grown *quinnat* weighs about twenty-five pounds, but individuals attain a much greater size, reaching as much as sixty pounds or even seventy. Those found in the Sacramento are, as a rule, smaller than those of the Columbia, not averaging more than eighteen pounds. In Puget Sound the *quinnat* are also smaller and less fat than in the Columbia.

The *quinnat* has from fifteen to eighteen branchiostegals, or small bones supporting the gill membranes; and has the body, dorsal, and caudal fins spotted with round spots. On the approach of the spawning season it becomes darker and sometimes, but not always, acquires a reddish tinge. The scales become covered with a coating of mucus so that the fish cannot readily be scaled. The pyloric cœca are very numerous, varying from a hundred and fifty to two hundred, so that it may be readily known by an examination of the stomach from *O. nerka*, which has about seventy-five very small cœca, and *O. keta*, which has from sixty to eighty large and thick ones. In this character *O. kisutch* and *O. gorbuscha* are near *quinnat*, but the branchiostegal rays of these species, like those of *nerka* and *keta*, are only thirteen or fourteen in number. *O. keta* has fewer spots than *quinnat*; the caudal has a few spots on its upper rays, and the dorsal a few on its first rays. *O. nerka* is *immaculate* as is *O. kisutch.*

Oncorhynchus keta, Silverside Salmon; Cohoe Salmon—The *tsuppitch* of Dr. Richordson has at length been identified by Professor Jordan as the *keta* of Walbaum. It turns out to be a salmon of the genus *oncorhynchus*, and not a trout as heretofore supposed. Its previous identification with the so called "Black Trout" of Lake Tahoe is thus found to have been an error. There is but one species of trout yet known from that lake, the presence or absence of teeth upon the hyoid bone being the result of accident or individual peculiarity. The real *tsuppitch* or *keta* reaches a length of fifteen to eighteen inches, and a weight of four or five pounds. When in the ocean, it feeds on crustacea, herring, etc. This salmon is said to be very superior in Quinnault River, where it is abundant and is salted by the Indians, as it is also at Neah Bay, at which point it was formerly canned. Professor Jordan saw it at Seattle, and speaks of it as abundant in Puget Sound and at Cape Flattery, as well as for some distance north and south from thence. As a food fish it ranks with the young of the *quinnat*. It runs up Eel River, California, and has been taken in the Sacramento.

Oncorhynchus nerka, Blueback; also called by fishermen, Rascal, Sukkeye, Redfish, Dog Salmon—This is a much smaller salmon than the *quinnat*, and apparently has its headquarters farther north. In the Columbia it is common, but less so than the *quinnat*, while in Fraser River and the streams of British Columbia generally it is the commonest salmon. It is often canned upon the Columbia, but without acknowledgment, as four of them are reckoned and paid for as one *quinnat*, although of course four *nerka* exceed in weight one of the latter.

In Puget Sound it is abundant, and ranges northward as far as the Aleutian Islands. It reaches eight to twelve pounds in weight. This species runs up the river principally in the Spring.

Oncorhynchus gorbuscha, Humpback—This species may readily be distinguished from the *quinnat* by the smaller size of the scales, and also, at least in the Sacramento, which it ascends in tolerable numbers in October, by the greatly developed hump formed by the dorsal outline immediately behind the head. *O. nerka* also becomes humpbacked, but not to so great an extent as the present species. The males, in the spawning season, present in perfection the character upon which the genus *Oncorhynchus* was founded, viz.: the hooked jaws, which give the fish a repulsive appearance. It does not appear to be a common species, except in Puget Sound, and does not exceed five to eight pounds in weight.

Oncorynchus kisutch, Dog Salmon—This, the true Dog Salmon, occurs in Puget Sound, Fraser River, etc. In most characters, except the scales, it agrees with the last species; but the scales are larger, and the aspect of the fish different. The males, when they enter the rivers in the fall, have reddish transverse bands alternating with greenish, and become blotched with these colors as they ascend. The females are bright silvery on entering the rivers.

Oncorhynchus kennerlyi, the Red Fish—This species appears to be, for the most part, an inhabitant of lakes that have no outlet, and is thus debarred from taking a trip to the ocean. Living in the lakes as ordinary salmon do in the sea, it runs up the rivers that flow into them, and deposits its ova in their clear water, just as other salmon run up the rivers flowing into the sea.

After spawning, other salmon become redder in their external coloration, and are "redfish," but this is the "Redfish" *par excellence* of the Indians, the valued fish of the lakes, to procure which they take long journeys.

The Redfish attains a weight of from four to five pounds.

Salmo henshawi, the Silver Trout—Two species of trout, *S. tsuppitch* and *S. henshawi*, commonly called the Black and the Silver Trout, were once supposed to inhabit Lake Tahoe and other lakes, but *S. tsuppitch* proves to be a salmon instead of a trout, leaving *Salmo henshawi* in sole possession as at once the Silver and the Black Trout of Lake Tahoe. Again and again has the writer examined the so called Black Trout of Lake Tahoe, in the endeavor to find any difference between it and the Silver Trout, and has failed. Head, teeth, gill-covers, fins, tail, all external characters of form, were alike. Yet the dealers make out two species; and in the Museum of the Academy of Natural Science we have what purport to be specimens of both, presented by the Acclimatization Society. These also I examined with the same result as with the fresh specimens. *Salmo tsuppitch*, the Black Trout, was said to be without teeth upon the hyoid bone. Occasionally a large trout without these teeth would occur, but invariably it was a particularly silvery and unspotted individual. If there were two species, it became evident that it was the Silver Trout that was without these teeth; yet other silvery trout had them. At last Professor Jordan claimed that he had found the real *tsuppitch* in the Columbia, and that he believed all the trout in Lake Tahoe were *henshawi*. It is well known that the delicate hyoid teeth become worn off by age or accident, in many cases. The Black Trout of the dealers must, therefore, be a myth, so far as species is concerned; yet, as those called "black" usually arrive here at a different season of the year than those called "silver" (which are often as dark as the black), it is not unlikely that there may be some peculiarity in the flesh, especially as the dealers profess to find a difference in firmness between them.

S. henshawi is sparsely covered with rather large dark round spots.

It reaches a weight of two or three pounds. Large quantities are sent from Wadsworth, on the Central Pacific Railroad, to the markets of San Francisco.

It is not confined to the lake it is named after, but occurs also in other mountain lakes, and in the Sacramento River, but it has not yet been traced to salt water.

Salmo irideus, the Brook Trout—This is the almost universally diffused brook trout of the streams of this State, and is, when adult, singularly handsome, glowing with peculiarly shaped spots or short bars of metallic golden green.

It has been generally catalogued as an exclusively fresh water fish, but it appears to share to some extent the anadromous habits of *Salmo salar*—as "sea trout"—possessing all the characters of *Salmo irideus* except the color, which is light, almost uniform, silvery, are frequently brought to the markets of San Francisco during the winter months, and there is little or no doubt that these are *iridea* which have left the streams for a more or less prolonged visit to salt water.

The fact is that all trout although for the most part inhabitants of fresh water, take occasional trips to the sea when the waters they inhabit are favorably situated for the purpose. *S. irideus* is usually of small size, not exceeding a foot in length, but under favorable circumstances reaches eighteen inches. In the Columbia it is rare, but Professor Jordan saw a few from a stream above Astoria.

The fish is seldom brought into the markets of San Francisco from fresh water.

Salmo mykiss, Hard-head, and Black Salmon—This is an exceedingly large trout, equal or superior in size to *Onc. nerka*, since it reaches a weight of from fourteen to eighteen pounds. It inhabits the mouths of large rivers, such as the Columbia, Fraser, Skeena, etc., and is occasionally found in Puget Sound. It appears to spawn in spring, somewat earlier than the salmon, and occurs upon the coast at the same time with the latter. It is believed to be migratory. In some regions it is esteemed as a food fish, but in the Columbia the flesh is very white, and it is considered valueless. The body is less deep than that of a salmon, and the tail much heavier.

Salmo clarki, Oregon Trout, Salmon Trout—This species is very abundant in all lakes and rivers north Mount Shasta, but is not found south of that locality. It is abundant in salt water in Puget Sound, where it is taken in seines in great numbers. It reaches a weight of from two to three pounds, and is reckoned an excellent food fish.

Salvelinus malma, Dolly Varden Trout—The Charr is abundant in the lakes and streams of the Cascade Range, from Central Oregon northward, and is also very common in the salt waters of Puget Sound, where many are taken in seines. Specimens obtained at Seattle and in the markets at Victoria reached a weight of eleven pounds, but in the mountain lakes and streams it does not exceed three pounds. Many are brought in by the Indians at the places before mentioned. It feeds freely on sticklebacks, herrings, etc., and is an excellent food fish.

The Dolly Varden trout of the Upper Sacramento, formerly known as *Salvelinus bairdi*, proves to be identical with this. Mr. Smith, who is stationed at the fish-hatching establishment upon the McCloud River, has examined many specimens, and finds that the characters relied upon to distinguish them utterly fail. Teeth are present upon the hyoid bone, in most examples from the McCloud, as in the typical *spectabilis*. The supposed absence of these teeth was the chief character upon which *bairdi* was based.

Hypomesus olidus, Surf Smelt—Professor Jordan did not meet with this fish south of Monterey, and states that it is very abundant in Puget Sound, where it spawns in the surf in the spring. It reaches nearly a foot in length, is very fat, and is held in high esteem as a pan fish. In the markets of San Francisco it is tolerably common, but seldom exceeds eight inches in length.

Osmerus pacificus, Eulachon, Candle-fish—The Eulachon has not yet been recorded from the coast of California, but is abundant from Oregon northward, ascending the rivers in enormous numbers, but for no great distance. In the Columbia, as well as in Fraser and Nass Rivers, it is especially abundant. In Fraser River the run is in May. On Nass River is a factory for making Eulachon oil, which is used as a substitute for cod-liver oil. When fresh it is one of the finest of pan fish. Many are pickled and shipped to San Francisco, where they are held in the highest esteem. Its use as Columbia River Sardines has been previously mentioned. The largest reaches a length of about ten inches.

Osmerus thaleichthys, Smelt, Small Silver-smelt—Tolerably common from Monterey Bay northward, but not running in such numbers as the two preceding smelts. It reaches six to eight inches long, and from its smaller size and softer flesh is less valued than the eulachon or surf-smelt. It rarely comes to San Francisco market in very good condition, and hence is less salable than the spurious smelts, of the family *Atherinidæ*.

Osmerus attenuatus, Slender Smelt—About equal in size to the preceding, but of a more attenuated form, with a straight lower jaw instead of a curved one, and a different upper surface of head. Not very common in the markets of San Francisco. Range not made out.

Albula vulpes. Lady-fish—This world-wide species, which, though by some classed with the herrings, differs from them in the rounded form of the abdomen, which in the latter is compressed and sharp-edged, and in the numerous pavement-like teeth of its mouth, is apparently resident at San Diego, where it is rather common, and is sold as a food fish along with the mullet. Its bright silvery coloration renders it salable, but it is not highly valued. It spawns late in the autumn, and reaches a length of about a foot.

FAM. CLUPEIDÆ—HERRINGS.

Including the Anchovies, this family has only five representatives upon the coast of California, only three of which reach San Francisco.

Clupea sagax, Sardine—This species occurs more or less abundantly in our markets throughout by far the greater portion of the year. In April and May those brought in are chiefly young, and it is commonest about July and August. The sardine may be distinguished from the herring by its thicker and more elongated body, somewhat longer head, and striated gill-cover, as well as by the total absence of teeth; by the even jaws (in the herring the lower jaw projects); by the narrow pointed form of the area included between the ridges on the top of the head, and by the row of spots on the sides. At San Diego it is even more abundant than at San Francisco, and is taken from the wharves with hook and line.

This species is very close to, if not identical with the *Clupea pilchardus* of Europe, the young of which are the sardines put up in oil that are so highly prized. It appears strange that no attempt in this direction has been made in California.

Clupea mirabilis, Herring—The herring of this coast is, on the whole, slightly smaller than that of the Atlantic, and since it is not salted or dried to any great extent, it does not figure so largely as an article of food. This, however, is not due to any scarcity of the fish, which occurs in shoals along the coast of California in the winter season, and is still more abundant northward. During some of the winter months, the bulk of the fish brought into San Francisco market consists of these species. In September the first of the season are taken. In November it becomes abundant, and in March or April falls off and disappears. Some have been cured in Humboldt Bay, but are said to be very poor; indeed, it is stated that the herring found along the Pacific Coast of the United States are far inferior to those taken between Puget Sound and Oonalashka. At the latter place the Alaska Fish Company put up a small quantity, and the Cutting Packing Company salt some at Sitka. The Indians press the whole fish for oil, and the spawn is kept to form part of their winter stock of food. At Puget Sound many barrels are sometimes taken at one haul of the seine. It reaches about a foot in length, and spawns in January at San Diego, but much later on the northern part of our coast. It is nowhere much valued.

Clupea (*alosa*), *sapidissima*, Shad—This species has prospered since its introduction into the Sacramento, and is now brought to market pretty regularly, although it still bears a high price. As in the Atlantic States, it descends to the sea at intervals, and the locality chosen by a large proportion of the species is the Bay of Monterey. Others scatter to a greater distance, as Professor Jordan took two examples on the Columbia River; and it has also been taken as far south as Wilmington. The largest shad I have yet heard of on this coast was sold in the spring of this year, by Messrs. Spence & Johnson, of the California Market. This individual measured twenty-six inches in length, nine and a half in width, and weighed eight pounds and a half. One of about the same dimensions, but not quite so heavy, was sold by the same dealers last year.

Stolephorus ringens, Anchovy—This is one of the most abundant of the finny tribe along the coast of California, and although not taken largely by the fishermen, is of great indirect service to man, since it forms a large part of the diet of other fishes. Even the tomcod, itself the prey of almost every fish used for food, devours its share of *S. ringens.* It frequents quiet bays. Two other species of anchovy occur in the southern part of California, viz.: *S. compressus* and *S. delicatissimus.* Both of these species differ widely in color from *S. ringens*, being yellowish, with a silvery streak along the flanks, instead of deep bluish.

In *S. compressus* the oval fin is much longer than in either of the other species. *S. compressus* reaches a length of about five inches, and is very abundant in the Bays of San Pedro and San Diego. It is not eaten, as its flesh is very dry.

S. ringens is chiefly used for bait, especially by the Chinese, who salt it for that purpose. In San Francisco market it is occasionally pickled with spices. It reaches a length of six inches.

S. delicatissimus is a very small species.

ORDER APODES, FISHES WITHOUT VENTRAL FINS.

This order, which includes numerous fishes having an extremely elongated form, with numerous vertebræ, very small branchial apertures, no ventral fins, and fin rays of simple structure, is but poorly represented on this coast, since only the specimens occur within the limits of California, and one or two others farther north. All of these are marine.

Muræna mordax, Conger Eel, Congaree—The Conger is abundant about Santa Catalina Island, and at San Diego, where it lives among rocks near tide marks, and may sometimes be taken on land. It is very pugnacious, striking like a snake. The flesh is fat and palatable like that of the fresh water eel, and as it reaches a length of five feet, and a weight of fifteen to twenty pounds, it is esteemed as food, although the skin is reputed to be poisonous.

ORDER CHONDROSTEI—STURGEONS.

The four species catalogued from this coast, have dwindled to two upon further examination. *Acipenser brachyrhynchus*, the large short-nosed sturgeon, of the Bay of San Francisco, proves to be identical with *A. transmontanus* of the Columbia River; while the *A. acutirostris* or sharp-nosed sturgeon of Ayres is the young of the same species.

The only other species, although no sharper-nosed than the preceding, must bear Ayres' name of *medirostris*, while the *A. acutirostiis* of Gunther (Cat. Fish. Brit. Mus. VIII. 344), and the *A. agassizii* of Dumeril, are but the young of this species. Both have the snout acutely pointed when young, and becoming more bluff with age.

Acipenser transmontanus, White or Common Sturgeon—This sturgeon is common in all bays and large rivers from San Francisco northwards, and is taken in great numbers on the Sacramento, Columbia, and Fraser Rivers. It feeds to a considerable extent on crustacea, and Fraser River gorges itself with the eulachon.

It runs up the rivers in the spring with the salmon. It reaches eight, ten, and even twelve feet in length, and a weight of six hundred pounds, but most of those brought to market are much smaller, from twenty-five to fifty pounds. The flesh is largely consumed in this city, and is very cheap. Much of it is smoked. The eggs are used as caviare, and are much esteemed by Germans and other Europeans.

Acipenser medirostris, Green Sturgeon — The distribution and habits of this species are the same as those of the preceding, but it is much less abundant, and though a large species, is probably inferior in size. It is not eaten, as it has the reputation of being poisonous. The smaller number of plates in the lateral line, the greater striation of all the plates, and the different position of the anal fin, are characters by which it is easily distinguished, to say nothing of the green color of the flesh, which is probably the cause of its bad reputation and certainly prevents its sale as "sea bass." The flesh is in reality as good as that of the white sturgeon.

CLASS—ELASMOBRANCHII.

The *Elasmobranchii*, or Sharks and Rays, are fishes of a generalized type, differing widely on the one hand from the true bony fishes, and on the other from the far less organized lampreys and myxines. In the days when it was believed possible to arrange all the forms of life in a straight line, ascending or descending, naturalists were puzzled to know where to place these creatures. In some part of their structure they seem to be as far above true fishes as in others they are below it. The brain is in many respects superior to that of a typical fish, such as a perch or salmon, and the arrangements for securing the reproduction of the species approach in complexity those of the mammalia. On the other hand, the skeleton is cartilaginous and imperfectly developed, and by far the greater number are without a gill covering. The development of the reproductive organs varies greatly in the different families and genera of this class; some are oviparous, but produce few and large eggs, while in others the young are hatched within the body of the mother, and in some species of sharks a rudimentary placenta is formed, the vascular wall of the umbilical sac becoming plaited, and interdigitating with similar folds of the walls of the uterus.

The great majority of the Teleostei, or true fishes, deposit an immense number of ova; but some, as the Embiotocidæ, or viviparous perch of this coast, are ovoviviparous, that is, the young are hatched within the ovary. In these cases, however, there is no trace of a placenta developed, as in the Elasmobranchs. But there is another and greater difference. In true fishes there is no union of the sexes. The milt of the male is squeezed out over the ova of the female—the two sexes, in some cases at least, assisting each other in the operation by rubbing their bodies together. But in the Sharks and Rays, fertilization is secured in the same manner as in all vertebrates above fishes, as well as in insects, crustacea, spiders, etc., namely, by the direct introduction of the male element into the female reproductive organs. In this respect the Teleostei, however specialized in other matters, took a step downwards, while the Elasmobranchs foreshadow, in their oviparous forms, the higher oviparous vertebrates, and in their viviparous forms the mammalia. While in the Teleostei the two sexes are usually much alike, and are distinguished externally only by slight differences in the form of the abdomen, or in the color (especially at the breeding season), the males of the Elasmobranchs may be readily distinguished by the pair of large organs known as "claspers," which are really intromittent organs.

The skin of the members of this class is more or less studded with calcified papillæ, forming, when the papillæ are numerous and thickly set, what is known as shagreen; and the entire skeleton is cartilaginous.

This class is divided into two orders, the first of which includes only the Chimæra and its allies, which are characterized by the coalescence with the skull of the cartilage forming the upper jaw and palate, and by the presence of a single gill-opening only, and the *Plagiostomi*, or Sharks and Rays, in which the jaws are distinct from the skull, and there are from five to seven gill-openings. The pouches within these branchial slits are narrow, and divided from each other by a membrane, but the respiratory processes do not extend to their edges, except in Chimæra and its allies.

The Sharks and Rays, the two sub-orders of the *Plagiostomi*, are distinguished from each other chiefly by the more or less cylindrical form and lateral gill-openings of the former, and the depressed body and ventrally situated gill-openings of the latter. But the two orders approach closely by such forms as the depressed monkfish and the sawfish (*Pristiophorus*), with lateral gill-openings, and the scarcely more depressed sawfish (*Pristis*), with gill-openings on the under surface.

ORDER HOLOCEPHALI—CHIMÆRAS.

Chimæra colliei, Rat-tail, Rat-fish—This species, the Pacific representative of the *Chimæra monstruosa* of the Atlantic, is by no means rare on all parts of the North American coast north of Point Concepcion, and is occasionally, on account of its bizarre appearance, brought into the market of San Francisco as a curiosity. In museums it is one of the most ordinarily occurring species, for every novice in icthyology who procures one, believes that such thing was never seen before, and forwards it accordingly.

The two sexes of the chimæra differ widely in appearance. The female is larger and stouter than the male, and has less singularity of form, but the smaller male has upon the snout a curious cartilaginous organ, armed with recurved teeth on its button-like extremity. This projection can be used on occasion as a weapon of defense, but its normal use is that of a prehensile organ, subservient to the purpose of reproduction. The claspers of the male are of complex structure.

While performing the reproductive act, the shorter male holds the female lightly grasped by the pectoral fin, by means of the hooked projection upon its forehead.

This fish frequents rather deep bays, feeds on fishes and marine invertebrates, and takes the hook readily. It spawns in July, and its egg-cases are long and slender, and unprovided with tentacles. The liver is extremely large and fat, but the fish, which does not exceed twenty to twenty-four inches in length, with a weight of from six to eight pounds, is too small to allow of its profitable pursuit.

SUB-ORDER BATIDÆ—RAYS AND SKATES.

In the typical rays, *Raiidæ Dasybatidæ*, the trunk is surrounded by the immensely developed pectoral fins, so that it forms a broad, flat disk, from which protrudes posteriorly a more or less long and slender tail. Some of the genera, however, approach the sharks, having a thick tail, and much of the body free from the pectorals. The gill openings are five in number, and are always on the lower surface of the body. Spiracles (breathing holes), are always present; there is no anal fin, and the dorsal fins, if present, are quite small and placed upon the tail. Fourteen species are now known to inhabit our coast, and all but three are peculiar to the west coast of North America. Previous to the visit of Professor Jordan, only seven were known to occur.

Myliobatis californicus, Stingaree, Sting Ray, Eagle Ray—This species is abundant along our coast at least as far north as Tomales Bay; and along the northern portion of its range is the only sting ray known. As the pectoral fins are not continued around the head, the sides of which are free, *Myliobatis* is not classed with the *Dasybatidæ.*

The Eagle Ray is especially abundant on sandy shores, and is very destructive to oysters, for the mastication of which, the broad flat surface presented by its hexagonal pavement like teeth is peculiarly fitted. It also devours crustacea and fishes, and reaches a weight of seventy-five pounds. It is not eaten by whites, but is occasionally dried by the Chinese.

Probably the same as *Myliobatis aquila* of the Mediterranean, Atlantic, and Australian Coasts.

Manta birostris, Sea Vampire—This gigantic species, which reaches fifteen to twenty feet in width, is said to occur on the extreme southern part of our coast. The mouth is wide, at the anterior extremity of the body, and contains teeth only in the lower jaw. These are small but numerous, in about a hundred longitudinal rows. This species is also called the Devil Fish, and has been said to carry down men beneath its outstretched pectorals. It is best known from the Atlantic, and is common in the Gulf of Mexico.

FAM. DASYBATIDÆ—STING RAYS.

Like the Raiidæ this family has the pectoral fins continued around the front of the head and confluent at the extremity of the snout, but unlike them the tail is armed with a strong serrated spine capable of inflicting considerable damage.

Three species are known to occur on our coast, one of which, *Urolophus halleri*, Round Sting Ray, is abundant in every bay and lagoon and along sandy shores south of Point Conception, especially in San Diego Bay. Although the smallest of the species, reaching a length of eighteen inches only, it is the most dangerous, having great muscular power in its tail and striking quickly and accurately. It is not eaten though often taken in nets. An example thus taken was seen by Professor Jordan to strike its "sting" quite through the body of another one.

Dasybatis dipterurus is rather abundant in San Diego Bay, and, in summer, many were seen of from two to two and a half feet in length, without the tail.

Pteroplatea marmorata, is far broader than it is long, reaching two and a half feet in width and two feet in length. It is common on bays and on sandy shores from Santa Barbara southwards. The large individuals taken at San Pedro are sent to Los Angeles, where they are eaten by the French residents. It is the only ray eaten there.

FAM. RAIIDÆ—RAYS, SKATES.

Five species of this family are now known to be found upon our coast, four of them discovered and described this year by Messrs. Jordan and Gilbert.

Zapteryx exasperatus, abundant in San Diego Bay in winter, is too small for use as food; and *Raia stellulata*, which in winter and spring is very abundant in Monterey Bay, is not sent to market on account of its very rough skin and dark brown color, which render it less salable than the other rays.

Large numbers of both adult and young are taken in gill nets. It reaches two to two and a half feet in length.

Raia rhina ranges from Monterey to Vancouver, is often taken with hook and line from the wharf at Seattle, and is brought to San Francisco market in company with the other rays. Elsewhere it is seldom eaten, and is nowhere much valued. It reaches a length of two and a half to three feet.

Raia binoculata, is on the whole the most abundant species of ray in the markets of San Francisco, and is common along the coast from thence to Monterey. Those brought to market are mostly caught in the immediate vicinity. It reaches a length of two to two and a half feet. The French are the chief consumers of this fish, and eat it in the form of *Raie avec buerre noir*.

Raia cooperi—This is the giant of its tribe, reaching a length of from five to six feet, and a weight of sixty pounds or more. Those sent to San Francisco market are usually much smaller, but examples three to four feet long may be seen there. From the preceding species it may be known at sight by the white spots upon its upper surface. It is abundant all along the coast from Monterey to Alaska, especially in Puget Sound, frequenting bays and sandy shores, and feeding on crustacea and fishes. It is taken both in nets and with hooks. Its egg cases, deposited in July, are about a foot in length, and squarish with short tentacles at the angles. It is seldom eaten except at San Francisco, and yields but little oil.

FAM. TORPEDINIDÆ TORPEDOES.

Torpedo californica is not often taken in the Bay of San Francisco, but is tolerably common in the Bays of Tomales and Monterey. The fishermen in the latter bay do not appear to have seen any very large examples, but in the spring of this year one was brought to this city from Tomales Bay of the respectable length of three feet and half an inch, and measuring two feet across the disk. The width across the ventrals was thirteen inches, the eyes were three inches apart, and the spiracles an inch in length. The Italian fishermen call it *Tremulo.* When fresh it is of a leaden color above, with darker spots, and white below.

FAM. RHINOBATIDÆ.

Rhinobatus productus, Shovel-nose Shark, Guitar—The name guitar refers to the form of this fish, intermediate between that of a ray and a shark, having the thick tail of the latter, and the expanded pectoral fins of the former. It is tolerably common in the Bay of San Francisco and abundant in those of San Pedro and San Diego, residing on muddy and sandy bottoms, and bringing forth its young in August. It reaches a length of two feet or more. The tail is eaten by the Chinese and Mexicans, but is not valued. Otherwise it is only used as a bait for lobsters (*Panulirus*).

Rhinobatus triseriatus, Guitar—This species is much more ray-like in its form than the preceding, the disk formed by the pectoral fins predominating entirely over the rest of the body, the hinder portion differs only from that of a skate by its somewhat greater thickness. But the true skates or rays (*Raiidæ*), are oviparous, while the present species, like the preceding and all the *Rhinobatidæ*, is viviparous. Three or four young are produced in each ovarial sac, and are brought forth in August. It reaches a length of two feet, and a weight of four pounds. It is not used.

SUB-ORDER SQUALI—SHARKS.

Until Professor Jordan commenced his researches this year, only nine species of sharks were on record from this coast, of which three only, viz., *Triacis semifasciatus*, *Notorhynchus maculatus*, *and Heterodontus francisi*, were peculiar to it. The list is now increased to twenty, but all the newly recorded species are well known forms inhabiting the opposite coast of the Pacific, or more commonly the Atlantic, and Mediterranean also, so that it appears probable that all the species found in the Atlantic will ultimately be found here.

None of the sharks are used as food by the white inhabitants of this coast, but oil is expressed from the livers of some, and "sharks fins" are sold to the Chinese. In Europe some of the smaller sharks or dog-fishes are eaten.

Some of the sharks have spiracles, or breathing holes, but others are without them; the dorsal fins are large, usually two in number, and placed upon the body, and an anal fin is usually present. In some of the species the eye is protected, like that of birds, by a nictilating membrane, or interior eyelid.

Squatina angelus, Angel-fish, Angelo, Monk-fish—This curious species is in many respects intermediate between the sharks and the rays, while it differs from both in the terminal position of the mouth. It is tolerably common in Tomales, San Francisco, and Monterey Bays, and thence southward. It reaches a length of five feet and a weight of seventy-five pounds, and ranges throughout the Pacific and Atlantic Oceans, as well as in the Mediterranean. The monk-fish has no anal fin, the pectorals are expanded horizontally, ray fashion, and the dorsals are situated upon the tail portion of the body.

Heterodontus francisi, Leopard Shark—This shark is found at least as far north as Monterey Bay, and is abundant at San Diego and San Pedro Bays. It spawns in winter, and its egg-cases are large, cylindrical, and a spirally twisted fringe around them. It reaches two and a half feet in length.

This species extends along the coast of Mexico, but is apparently distinct from the Australian species. The family to which it belongs is remarkable for its broad rolls, formed by the oblique series of large lateral teeth in the jaws.

Notorhynchus maculatus—This shark has seven gill openings, has been found at several points from Monterey northward to Puget Sound. The teeth of the lower jaw are set with numerous cusps upon their exterior edges. It attains a length of seven feet or more. Professor Jordan has lately obtained of a species of *Hexanchus* having six gill openings on each side. This he has named *H. corinus*. These species have one dorsal only; and the eye is without a nictitating membrane.

Alopias vulpes, Fox Shark, Thresher—This species does not appear to be common upon this coast, but undoubtedly occurs. It is reported by Ayres from Tomales Bay; and a tail, which in this fish is nearly equal in length to the rest of the body, and is thus enough for identification, was found by Professor Jordan at Monterey. It is occasionally taken in seines at Soquel.

This species is found also in the Mediterranean and the Atlantic. The story that it attacks the whale appears to lack proof, as it is difficult to understand how it could inflict much mischief on so large an animal by striking it with its tail as is reported. It reaches a length of thirteen feet.

Catulus ventricosus, Ground Shark, Puffer Shark—This species does not appear to occur north of Monterey Bay, but is tolerably abundant at Santa Barbara in the winter, where it lives among the kelp, and is often caught in the lobster-pots set to catch the craw-fish or spiny lobster (*Panulirus interruptus*), which is sent from Santa Barbara to San Francisco in great numbers. The pots are baited with salted fish of which the puffer appears to be very fond. None are seen in summer. This shark has acquired its vernacular name from its habit of inflating its stomach with air, after the fashion of a globe fish (*Diodon. Tetrodon*), when it is made prisoner. It reaches two and a half feet in length and is of no value to man. In February the eggs are ready for extrusion, and this may account for its presence near shore. The egg cases are flat, oblong, and quadrangular, with very long tentacles at the angles.

Cetorhinus maximus, the Basking Shark—This is one of those widely spread forms that inhabit both the Pacific and the Atlantic;

occurring alike off the coasts of Ireland and California. It is one of the giants of the finny tribe, attaining a length of more than thirty feet, but, spite of its size, is one of the least formidable of sharks. Its teeth are very small; showing that, like the giant cetaceans, it is not adapted to prey upon large animals. Its presence on this coast was not known to naturalists until Professor Jordan noted its presence in Monterey Bay. The first example measured was thirty-one feet in length. Since then, others have been brought or cast ashore.

The name of Basking Shark has been given to this fish on account of its lazy habit of resting upon the surface of the water, with its dorsal fin exposed.

It is occasionally harpooned in Monterey Bay, and now and then becomes entangled in the gill nets. The livers are utilized for oil.

Sphyrna zygæna, Hammer-head Shark—This shark appears to be tolerably abundant in Lower California, since several examples were obtained there by W. I. Fisher in 1876 and 1877, one of them about fourteen feet long. An example, taken at San Pedro, was sent to the Smithsonian Institute by Dr. Cooper. None of the finny inhabitants of the seas can show a more singularly shaped anterior extremity than this species, which has its eyes placed at the end of the transverse prolongations of the head, each of which is as broad as it is long. The species occurs in all tropical and sub-tropical seas.

Mustelus hinnulus, the Dog Shark, and *Rhinotriacis henlei*, also called the Dog Shark, are usually about two feet and a half long, but occasionally more, and are used only for bait. The former is known to feed chiefly on crustacea and small fish. Neither are on record north of San Francisco. Both are Atlantic species.

Triacis semifasciatus, Leopard Shark, Cat Shark—This species is abundant in Humboldt Bay, and thence southward, and is very common everywhere, frequenting sandy shores and entering lagoons in summer to spawn. It attains a length of five feet, but yields hardly any oil, and thus is of no economic value. Peculiar to this coast.

Galeorhinus galeus, Tope, Oil Shark—Very abundant everywhere south of San Francisco from May to August, when it enters lagoons to spawn, and is taken in great numbers for the oil furnished by the liver. Soquel and Monterey, and more especially Westminster and Newport, near San Luis Obispo, are the places where this fishery is carried on. It feeds on any other fish, but herring and similar silvery fish make the best bait. It attains a length of five feet, and a weight of fifty or sixty pounds, but thirty-five to forty pounds is more usual.

From two thirds of a gallon to a gallon of oil is obtained from the liver. The pectoral, dorsal, and caudal fins are cut off and sold to the Chinese, at twelve and a half cents per pound, for soup fish.

The Tope occurs in all temperate and tropical seas, as do also *Galeocerdo tigrinus*, *Carcharinus glaucus*, and *Eulamia lamia*. The second of these is the Blue Shark of the British coast, and attains a length of eleven feet.

Lamna cornubica (Porbeagle); *Isurus oxyrhynchus*—These two allied species seem to be rare on this coast, yet undoubtedly occur. Doctor C. L. Anderson, of Santa Cruz, has a drawing of an example of the former species taken at that place in 1879, and the jaws of another specimen were procured by Professor Jordan at Wilmington. A small individual of the latter species was sent from Monterey Bay to San Francisco in August last as a curiosity, and was secured by Professor Jordan. It is common in the British Channel, and occurs in the Mediterranean, in the Atlantic Ocean, and on the shores of Japan.

The *Isurus* is found on the Atlantic Coast of the United States.

Carcharodon carcharias, Man eater, White Shark, Great Blue Shark—The White Shark, the terror of the waters, the "man eater" who swallows sailors and carries off innocent bathers, has been found in Monterey Bay. Lest this announcement should bring ruin to the bathing-houses of Santa Cruz and Monterey, it is well to remark that either because of his comparative rarity, or because he has not yet learned to relish the taste of Caucasian flesh, he does not appear to have ever made off with any of the fair Nereides who frequent those well known beaches Professor Jordan secured the jaws of an example twenty feet in length, taken at Soquel this year, and records the capture of one twenty feet in length at Carmelo. A few years ago a young sealion, weighing one hundred pounds, was taken from the stomach of one of these monsters caught at Soquel.

The only useful part of this fish is the liver, from which oil is expressed. This large and dangerous shark, which attains a length of thirty-six feet, occurs in all oceans and large seas of temperate and tropical regions.

Somniosus microcephalus, Black Ground Shark, Nurse Shark—This species is not recorded south of Puget Sound, where it is not very uncommon, and is occasionally taken on trawl lines set for dog-fish. It attains a length of eight feet, and is very sluggish, lying in the water like a log. The livers are used for making "Dog-fish Oil."

Squalus acanthias, L., Dog-fish, Spinarola—The "Piked Dog-fish," is found at Santa Barbara and Monterey, but is not abundant south of Puget Sound, where it is taken in vast quantities for the oil in its liver. It has a long spine before each of the two dorcals.

It inhabits deep or quiet bays and channels, and comes into shallow water in pursuit of schools of herring and salmon. Its chief food is the herring, but it eats everything it can, even its own young, which in Puget Sound are born in June.

It reaches a length of three feet, and inhabits all temperate seas of both the northern and the southern hemispheres. It occurs on the coast of Alaska as far north as Kodiak.

CLASS MARSIPOBRANCHII.

Entosphenus tridentatus, Large Lamprey—The species of Lamprey, formerly supposed to be five, have under investigation dwindled to two, namely the small *Ammocœtes plumbeus* and the large *Entosphenus tridentatus*.

The latter reaches a length of two feet, is extremely fat, and has been observed at various points from Santa Cruz to Puget Sound. Like other lampreys it ascends rivers in spring to spawn. It runs up the Columbia in June. In Humboldt county, and probably elsewhere, it is occasionally eaten.

Ammocœtes plumbeus, the small Lamprey or Lamperina, is very thin and small, often only about six inches long, and never over a foot.

Polistotrema dombeyi, Hag—The habits of the Myxines or Hags are, in a general way, well known, but the writer had never witnessed the result of their ravages until this summer, when, on a visit to Monterey, where it is especially abundant, he was shown by Professor Jordan several rock cod which had been literally eaten alive by them, and had washed ashore mere shells. The hag enters by the gills, or occasionally by devouring the eye, and eats its way into the flesh of its victim, consuming it until it dies of weakness, but presumably leaving, like the ichneumons that prey upon butterfly caterpillars, the vital parts untouched till last. Shells of fishes thus eaten are frequently found in Monterey Bay, and are usually quite fresh, as if but just dead. The hag is fitted for its work by its suctorial mouth, terminal, soft, unprovided with jaws, and forming a round opening when in use, as well as by two rows of teeth on each side of the gullet. The mouth is surrounded by barbels, and in preserved examples is scarcely visible. The aspect of the hag, the lowest of vertebrates except the lancelet (if the latter has any right to be called a vertebrate), is strongly suggestive of a relationship between worms and vertebrates, and the observer can scarcely maintain the superiority of such a creature as this over beings organized as intricately as insects and crustacea. In form it is wormlike. There is no fin above or below to break the continuous round body, and the barbels suggest a worm, rather than a vertebrate; yet a vertebrate it undoubtedly is, having the nervous system and backbone of a vertebrate, although the former is of low order, and the latter is but a cartilaginous rod, with a rudimentary cranial expansion at its anterior extremity.

This species, which is widely spread, was first noticed as Californian by myself, and was described as new, under the name of *Bdellostoma stouti*, from an example taken in Eel River, Humboldt County, California—a river which derives its name not from the presence of eels, but of lampreys and hags, both of which are sold for food as eels. The number of gill openings is not—at least in some examples—equal on both sides, but is twelve on one side and eleven on the other.

The fishermen of Monterey declare that one of these parasitic fishes will devour a fish of six to eight pounds weight in a single night. It is especially destructive to fish taken in gill-nets. When the hulk is taken out of the net, the hag scrambles out with great alacrity. It reaches a length of fourteen inches, and is not used for food at Monterey.

RECEIPTS AND EXPENDITURES.

The following is on account of receipts and expenditures since our last report:

Receipts.

November 1, 1879—By cash on hand as per last report	$3,873 70
July 29, 1880—By cash, State appropriation	5,000 00
Total	$8,873 70

Expenditures.

November 1, 1879—To paid H. C. Marks, balance due, copying report for printer	$60 00
November 23, 1879—To paid Cowdery & Preston, attorneys, in suits in Fishways, Stanislaus, and Merced	23 00
December 24, 1879—To paid expense in transporting 300 carp from Washington	33 55
December 27, 1879—To paid Livingston Stone, on account of hatching 2,500,000 salmon	1,054 50
January 1, 1880—To paid half month fish hatching, J. G. Woodbury, December, $75; coas oil, express, wood, and sundries, $23 45	98 45
January 3, 1880—To paid postage on reports, $5; express on 50,000 trout eggs, $22 60	27 60
January 26, 1880—To paid L. Stone, 50,000 trout eggs, $204 80; S. P. Baird, eleven fish cans, $73 60	278 40
January 26, 1880—To paid H. Pither, 2,500 cat-fish, barrels, and express	80 60
January 26, 1880—To paid drafts exchange, $1 00; Wells, Fargo & Company, expressage on cat-fish, $9 75	10 75
January 31, 1880—To paid Stratton, cartage, $2; brush and broom, $2 35	4 35
January 31, 1880—To paid J. G. Woodbury, on account of January, fish hatching	30 00
February 3, 1880—To paid J. A. Richardson, three quarter month's labor, January	75 00
February 16, 1880—To paid Marks, copying notices, $10; J. G. Woodbury, on account of fish hatching, $60	70 00
February 20, 1880—To paid expense for distributing cat-fish in Alameda	6 40
March 6, 1880—To paid drayage and express, $2; Woodbury, balance for January, fish hatching, $60	62 00
April 3, 1880—To paid two telegrams, $1 15; Stratton, cartage, $7; brush, etc., $2 50	10 65
April 26, 1880—To paid J. B. Campbell, 33,000 trout eggs, $100; express, etc., $3 50	103 50
April 26, 1880—To paid J. A. Richardson, three months' labor to May first	300 00
May 6, 1880—To paid freight, express, salt, telegrams, paint, and other items	18 85
May 6, 1880—To peid Woodbury, three months' fish hatching to May first	450 00
June 7, 1880—To paid People's Ice Company's bill, ice, February to May	38 80
June 17, 1880—To paid fare of assistants for transporting shad to Tehama	38 25
June 25, 1880—To paid express on cans from Yosemite	90
July 1, 1880—To paid Woodbury, expenses on carp for Mare Island	24 65
July 15, 1880—To paid Marks, on account of labor, copying	20 00
July 16, 1880—To paid A. W. Von Schmidt, examination of dams on Pitt River	100 00
July 30, 1880—To paid Marks, balance for labor, copying	80 00
July 30, 1880—To paid H. Pither, expense for distributing 5,300 cat-fish	122 70
August 2, 1880—To paid H. Pither, expense for distributing 2,500 cas-fish	55 50
August 2, 1880—To paid L. Stone, balance due on hatching 2,500,000 salmon	45 50
October 11, 1880—To paid express on fish cans to San Leandro	1 00
December 8, 1880—To paid Lockington, report on Pacific Coast fish	100 00
December 8, 1880—To paid Wells, Fargo & Company, express on cans, $1; J. H. Stone, salmon statistics, $50	51 00
December 8, 1880—To paid Marks, on account, copying report	20 00
December 17, 1880—To paid H. Pither, catching, transporting, and distributing 2,750 cat-fish	95 50
December 22, 1880—To paid H. D. Dunn, gathering salmon statistics	20 00
December 22, 1880—To paid L. Stone, hatching 2,250,000 salmon	1,002 50
January 3, 1881—To paid galvanized wire	1 25
January 3, 1881—On hand to balance	4,258 55
Total	$8,873 70

This balance of $4,258 55 will be consumed in the hatching of native and foreign fish during the present Winter, and in the importation of striped bass and shad in the Spring.

All of which is respectfully submitted.

B. B. REDDING,
S. R. THROCKMORTON,
J. D. FARWELL,
Fish Commissioners.

LIST OF FISH COMMISSIONERS.

UNITED STATES.

Prof. Spencer F. Baird------Washington, D. C.

ALABAMA.

Charles S. G. Doster --------------Prattsville.
D. B. Hundley --------------------Courtland.

ARKANSAS.

N. B. Pierce --------------------Osage Mills.

CALIFORNIA.

S. R. Throckmorton -------------San Francisco.
B. B. Redding ------------------San Francisco.
J. D. Farwell--------------Niles, Alameda Co.

COLORADO.

W. E. Sisty -----------------------Brookvale.

CONNECTICUT.

W. M. Hudson ----------------------Hartford.
Robert G. Pike -----------------Middletown.
G. N. Woodruff---------------------Sherman.

GEORGIA.

Thomas P. James---------------------Atlanta.

ILLINOIS.

N. K. Fairbank----------------------Chicago.
S. P. Bartlett-------------------------Quincy.

IOWA.

B. F. Shaw------------------------Anamosa.

KANSAS.

D. B. Long------------------------Ellsworth.

KENTUCKY.

Wm. Griffith, President ------------Louisville.
Hon. John A. Sleel-------------------Midway.
Dr. Wm. Van Antwerp---------Mount Sterling.
A. H. Goble ---------------------Collettsburg.
Hon. C. J. Walton -------------Munfordsville.
Dr. S. W. Coombs -------------Bowling Green.
John B. Walker------------------Madisonville.
W. C. Price--------------------------Danville.
P. H. Darby------------------------Princeton.
Hon. M. J. Chambers-Independence, Kenton Co.

MAINE.

E. M. Stilwell-------------------------Bangor.
Everett Smith------------------------Portland.

MARYLAND.

Major T. B. Ferguson ---------------Baltimore.
Thomas Hughlett-----------------------Easton.

MASSACHUSETTS.

Theodore Lyman ------------------Brookline.
E. A. Brackett--------------------Winchester.
Asa French ----------------------------Boston.

MICHIGAN.

Eli R. Miller-------------------------Richland.
A. J. Kellogg ----------------------------Detroit.
Dr. J. C. Parker----------------Grand Rapids.

MINNESOTA.

Daniel Cameron--------------------La Crescent.
Wm. W. Sweeney, M. D.------------Red Wing.
R. Ormsby Sweeney -------------------St. Paul.

MISSOURI.

Hon. Silas Woodson -----------------St. Joseph.
Hon. H. Clay Ewing-------------Jefferson City.
John Reid-------------------------Lexington.

NEBRASKA.

R. R. Livingston ----------------Plattsmouth.
H. S. Kelley-----------------------Red Cloud.
W. L. May----------------------------Fremont.

NEVADA.

H. G. Parker---------------------Carson City.

NEW HAMPSHIRE.

Samuel Webber ------------------Manchester.
Luther Hayes -------------------South Milton.
Albina H. Powers -------------------Plymouth.

NEW JERSEY.

Dr. B. P. Howell -------------------Woodberry.
E. J. Anderson -------------------------Trenton.
Theo. Morford---------------------------Newton.

NEW YORK.

Hon. R. B. Roosevelt-----------------New York.
Edward M. Smith--------------------Rochestér.
Richard U. Sherman -------------New Hartford.
Eugene G. Blackford-------------------Brooklyn.

NORTH CAROLINA.

P. M. Wilson ----------------------------Raleigh.

OHIO.

J. C. Fisher ------------------------Coshocton.
R. Cummings -------------------------------Toledo.
L. A. Harris --------------------------Cincinnati.

PENNSYLVANIA.

H. J. Reider -----------------------------Easton.
B. L. Hewitt ----------------------Hollidaysburg.
James Duffy -----------------------------Marietta.
John Hummel----------------------Selingsgrove.
Robert Dalzell ---------------------------Pittsburg.
G. M. Miller ---------------------------Wilkesbarre.

RHODE ISLAND.

Newton Dexter------------------------Providence.
John H. Barden -------------------------Rockland.
Alfred A. Reid -------------------------Providence.

SOUTH CAROLINA.

A. P. Butler	Columbia.

TENNESSEE.

W. W. McDowell	Memphis.
George F. Akers	Nashville.
Hon. T. W. Turley	Knoxville.

TEXAS.

J. H. Dinkins	Austin.

UTAH.

Prof. J. L. Barfoot	Salt Lake City.

VERMONT.

Dr. M. Goldsmith	Rutland.
Charles Barrett	Grafton.

VIRGINIA.

M. McDonald	Lexington.

WEST VIRGINIA.

Henry B. Miller	Wheeling.
C. S. White	Romney.
N. M. Lowry	Hinton.

WISCONSIN.

Governor William E. Smith	Madison.
Philo Dunning	Madison.
J. V. Jones	Oshkosh.
C. L. Valentine	Janesville.
Mark Douglas	Melrose, Jackson Co.
John F. Antisdel	Milwaukee.
C. Hutchinson	Beetown, Grant Co.

CANADA.

W. H. Whitcher	Ottawa, Ontario.
S. Wilmot	New Castle, Ontario.

NEW BRUNSWICK.

W. F. Venning	St. John.

NOVA SCOTIA.

W. H. Rogers	Amherst.

PRINCE EDWARDS ISLAND.

J. H. Duvar	Alberton.

BRITISH COLUMBIA.

Alex. C. Anderson	Victoria.

REPORT

OF THE

COMMISSIONERS OF FISHERIES

OF THE

STATE OF CALIFORNIA,

FOR THE

YEARS 1881 AND 1882.

7948

REPORT.

To his Excellency George Stoneman, *Governor of California:*

The Commissioners of Fisheries of the State of California, appointed under an Act of the Legislature, entitled "An Act to provide for the restoration and preservation of fish in the waters of the State," approved April 2, 1870, respectfully submit their seventh report.

SACRAMENTO SALMON.

The marked increase in the demand for salmon by the canning establishments, arising from the growth and extension of that important industry, has induced the Commission to endeavor to increase the supply of this valuable fish, in order, if possible, to keep pace with the demand; and we now have the gratification of reporting the successful hatching and distributing, this season, of four millions of salmon in the waters of the State. The success of the artificial breeding of this fish which has attended our former efforts, has led us to believe that the Sacramento River may be made to produce an almost unlimited supply, and with this view of its capabilities, we have this season commenced the experiment of placing in that river and its tributaries double the number heretofore planted. If this large planting should give the same evidence of success in the increase of fish which the planting of former years has exhibited, it will go far towards encouraging the hope that the Sacramento River may be made a great "fish farm," from which may be supplied all the salmon that a largely increased business of the canning interests may require. That the artificial breeding of salmon has largely increased the run of fish in the river, is too clearly demonstrated in the increased production of the canning establishments, to admit of a doubt.

It will be seen, by referring to former reports, that the business of the canning of salmon has been as follows:

For the season ending August 1, 1875	5,098,781 pounds.
For the season ending August 1, 1876	5,311,423 pounds.
For the season ending August 1, 1877	6,493,563 pounds.
For the season ending August 1, 1878	6,520,768 pounds.
For the season ending August 1, 1879	4,432,250 pounds.

Now we come to the results, as we think reasonably indicated, of the artificial breeding.

It is a well settled fact that the reproduction of the salmon to its full size requires four years; consequently the "output" of 1880 is the first result of former planting. We now have the gratification of registering the increased production as follows:

For the season ending August 1, 1880	10,837,400 pounds.
For the season euding August 1, 1881	9,600,000 pounds.
For the season ending August 1, 1882	9,605,280 pounds.

This increase of production cannot reasonably be credited to an increase in the number of canning establishments, as it is well known that no such sudden and large increase of such facilities has taken place; nor can it fairly be attributed to chance runs of fish into the river. It is too regular and well sustained to be the result of accident.

In addition to the amount of salmon canned for export, it will be seen by the detailed report of transportation, that 6,713,408 pounds of salmon have been taken for home consumption. It may be well here to add that the above statistics are not mere estimates, but reliable information obtained from parties engaged in this business, and from registers of internal transportation.

The Commission has much satisfaction in being able to report that there now appears to exist a more harmonious feeling upon the necessity of preserving the fish in our rivers. During the year last past, from all the information we have, there has been exhibited, on the part of the conductors of the canning business, a fair and earnest desire to enforce the close season, and a commendable realization of the importance of preserving the fish from wasteful destruction, and allowing them to reach their breeding grounds in sufficient numbers. But still there has been a great deal of surreptitious violation of the laws by itinerant fishermen, whose depredations can only be prevented by the people in the immediate neighborhood assisting in enforcing the law; for it may here, we think, be pertinently remarked, that the "American citizen," whilst exhibiting the highest order of natural ability for the making of laws, seems to almost entirely overlook the fact that it is also his privilege and duty, individually, to aid in the enforcement of them. It has been frequently suggested to the Commissioners, that they ask the Legislature for an additional appropriation for the establishment of a "patrol police," to enforce the laws as against these desultory depredations. We cannot see the expediency of such an extravagance, for extravagance it would be. It would cost more to keep it up than any possible benefits derived from it. There is no actual necessity for large expenditure by this Commission, and the simpler and more economically it is conducted, the better will the State be served.

STRIPED BASS.

During the last year we have repeated the effort of introducing this valuable fish into the waters of the State, and we may add, this coast, for it is a sea-going fish, as well as an inhabitant of inland waters.

On the Eastern coast of the continent there is no other fish so highly valued. It is exceedingly prolific. It inhabits the fresh waters during all the Spring and Summer months, running in schools and taking the hook readily, and varying in weight from one to five pounds. When it takes on its sea-going form, it becomes a noble fish, reaching in weight from seventy to one hundred pounds, and still at even this great size, never losing its delicious flavor. We subjoin the report of Mr. J. G. Woodbury, the present Superintendent of the State Fishery, who made the trip East during the last Summer especially to bring out the striped bass, and whose success in the difficult task of bringing across the continent fish of so large a size will best illustrate his skill and care in so difficult an undertaking. It is hoped by the Commission that this importation will soon exhibit its results:

REPORT OF J. G. WOODBURY ON STRIPED BASS.

San Francisco, July 31, 1882.

S. R. Throckmorton, Esq., Chairman California Fish Commission:

Dear Sir: In accordance with your instructions to bring from the Atlantic Coast waters a lot of striped bass fry, for the purpose of stocking the waters of the Pacific Coast, I proceeded directly to Red Bank, New Jersey, which is on the Shrewsbury River, a few miles from the ocean, from whose tidal waters it was known that young bass could be conveniently caught, being the same place to which Mr. Livingston Stone had, on a former occasion, been directed by your Commission. I arrived at Red Bank on June twenty-seventh, and, with a letter of introduction, called upon Mr. G. H. Wild, the gentleman with whom you had been communicating in regard to the best season for catching young bass. Mr. Wild, who had previously interested himself in getting a permission from the New Jersey Fish Commissioners allowing the Shrewsbury River to be seined for the young bass we desired to obtain, now heartily lent his aid in securing men, boats, and seine to help catch the young fry. The next thing was to devise some means to keep the young bass in safety, as they were caught from day to day, and where they could be conveniently examined and fed if needful until the proposed number had been caught. For this purpose I adopted the suggestion you made to me before leaving San Francisco, which was to make a cage for them and anchor it in the current of the river. This cage was to be six feet long by three feet square (to suit the width of the wire), the bottom and top to be of boards, and the sides of galvanized wire to permit a free circulation of the water, the top to have a door for easy access. Mr. William E. Cole, a well known merchant of Red Bank, in his kindly interest in the success of our enterprise, insisted upon making this cage himself, which he did in a very satisfactory manner, thus giving me more time to devote to other urgent matters. You had written to Mr. Seth Green, Superintendent of the New York Fish Commission, to send a man experienced in catching and handling fish, and also a seine, to Red Bank, to meet me on my arrival from California. This gentleman (Mr. E. L. Marks), owing to some delay consequent on making a shipment of fish, did not reach Red Bank until the second day after my arrival. The seine which Mr. Green sent was too small to be of much use in the Shrewsbury, while the one I had secured in Red Bank was so much torn that nearly two days were consumed in repairing it. On the fifth day we had gotten the cage into the river and anchored it in a strong current, under the bridge; the seine had been repaired, and we made several hauls, catching about fifty fish. This was so encouraging that it led us to expect that the number of bass desired might be easily caught, although the fish were not so small as I had hoped. I now left Mr. Marks in charge of catching the bass, while I attended to other matters necessary to the success of our enterprise, such as getting cans made for transporting the fish to California, securing transportation passes in the baggage car over the railroads, etc. In New York I ordered made twelve cans like the New York Fish Commissioners' cans for transporting trout. These cans will hold about fourteen gallons each, and are made of the heaviest tin, strongly bound. The cans are so constructed as to give the largest possible air surface to the water, and they will be of good service to the Commission in the future. Three ten-gallon cans were also ordered for carrying extra water; they have wooden jackets, and are the same as those used by the United States Fish Commission in transporting young shad. Also, four strong pails for carrying water. These cans and pails were to be finished at a certain time, but owing to the Fourth of July intervening, and the warm spell which prostrated some of the workmen, they were not ready for delivery until a week after the time promised, consequently we were not able to start on our journey until several days after our fish had all been secured. Through the kindness of Professor Spencer F. Baird, United States Fish Commissioner, and his assistants, I received much practical information in relation to transporting fish on long journeys, and specially such as was pertinent to the trip I was about to begin. Professor Baird also kindly furnished me with free transportation passes for our outfit in the baggage cars over the different railroads.

While at Red Bank I had received a letter from you, with instructions to bring back some large eels for breeding purposes. I therefore went down to the eel-fishing grounds below Highlands, and near the mouth of Shrewsbury River, to make arrangements to have some caught and delivered at Red Bank a day before our departure for California with the striped bass.

As the striped bass was the first consideration, the floor space allotted to our use in the baggage car was all reserved for them. For carrying the eels I therefore proposed light boxes, so that they might be hung to hooks on the walls of the car over the fish cans. These boxes were similar to cheese hoops, with a bottom having holes in it for circulation of air, and a cover also having holes in it, which would drop loosely into the top of the box and find a resting place on lugs about two inches below the top. The two-inch space at the top was reserved for ice, so that, as it melted, the cold water would drip through upon the eels below. To the outer rim of the bottom was suspended a shallow tin dish to catch the dripping water, and so prevent the floor of the car becoming sloppy from this source. I knew that eels would live a long time if put in a cool place and their gills kept moist. With this fact in view, I arranged the boxes as above described, and intended putting the eels in boxes among eel grass, and to keep them moist by pouring over them, every few hours, a dipper full of waste water from the striped bass, and thus obviate the necessity of taking any extra water for the eels. To keep them cool, a small piece of ice placed on the cover to slowly melt and drip through on them would meet the requirements at little expense.

In consequence of the excessive hot weather, all the eels that were put into the cages died before we were ready to start with them. I therefore brought with me but ten eels (as an experiment), which were caught near our bass-fishing grounds on the night before our departure. These were put into a box as above described, and in addition to wetting them down three or four times during each twenty-four hours, and keeping a small piece of ice on the cover, they were every day given a bath for a few minutes in the waste water from the bass, which they seemed to enjoy hugely—the eel-grass being well rinsed and the box washed out. These eels were from twelve to twenty-four inches long. They all came through in fine condition, and were put into the bay near where the striped bass were planted, in water about a foot deep, on the edge of the tules. On being put into the water, they immediately bored straight down into the soft mud, and in a moment were all out of sight.

The weather had been excessively warm, raising the temperature of the water at times, where the fish were caught, to 84° Fahrenheit. When about three hundred had been secured, the fish being much larger than was anticipated, and some of them showing signs of distress on account of close confinement in such warm water, a second cage was built. The men continued fishing until July fourteenth, and, according to their count from day to day, had caught about six hundred, although all of this number were not in the cage when the fishing was discontinued, for some had died from bruises caused by careless handling; the temperature of the water causing the fungus to grow very rapidly where the scales had been rubbed off or discoloration produced from a bruise. Those that had been put into the first cage were supposed to be getting somewhat hungry after going without food for a week, therefore they were fed with some chopped liver, and their desire for food was so much stronger than their instinct of fear, that they eagerly rushed for the food as it was put into the water, even taking it from the hand as tame trout will often do. It was noticed that the bass in the second cage would not take food until they had been several days in confinement.

We now had all the fish we could carry in the space allotted to us in the car, and we only awaited the arrival of the cans from New York, which were promised to be ready for shipment on Saturday morning. Arrangements were made to start for home on Monday afternoon, July seventeenth. Mr. Marks, whom I had engaged to assist me in the care of the fish on the trip to California, was to see that the bass were gotten into the cars all right, so that we might start on the 4:55 P. M. train for Jersey City. While in an endeavor to get some eels to take along, I was obliged to be away until one o'clock of this, to us, important day, on a trip to Seabright and Parkerstown. Thirty-five of the larger bass were put into each of six cans, and forty of the smaller ones into each of the six other cans. These bass were from five to nine inches in length, and would average six and one half inches long. I had been advised by men experienced in handling fish to put no more than twenty-five in each can to take on such a long trip; but I knew that some of the weaker ones, with the best of care, would probably die, and being very anxious to get through with as many bass as possible, we had resolved to give them more than the usual amount of aeration and careful attention. It was decided to take the risk of the cans being somewhat crowded. The warm, brackish water of the Shrewsbury was used to fill the cans, and, after the fish were put in, the water was cooled down with ice. While the water was being cooled down, some of the bass showed signs of distress, and, while at the river bank, some of them died, perhaps twenty. At the railroad station, and before getting the cans on the cars, we lost about as many more. During the excitement of attending to the fish, paying bills, and seeing that all of our traps were put aboard, no one thought of counting the dead fish. Besides the twelve cans of fish, we had three cans of extra water and one box of eels; and with the ice, pails, aerating apparatus, and our own baggage, we took up considerable room in the car. Mr. J. A. Throckmorton, a prominent citizen of Red Bank, who had rendered us much assistance, and to whom I am indebted for many personal favors, also Mr. G. H. Wild, who, from the first, had been unremitting in his assistance, came to the station to wish good luck and bid us good-bye. I am also greatly indebted to Mr. William E. Cole for many kind favors. After the fish were on the train, we gave our whole attention to cooling down and aerating the water, which was soon lowered to about 60° Fahrenheit, at which temperature, a little above or below, we kept it all the way to the Pacific Coast.

On the way to Jersey City, and during a detention there of two hours to connect with the Pacific express train, twelve more of the bass died. During the night, some time after passing Philadelphia, two more were found dead, which made fourteen all told since leaving Red Bank. Most of these had shown signs of distress by occasionally turning on their sides. A considerable number of those picked out had either lost some of their scales or had contusions, and some had the "water-louse" fastened to their gills. These parasites were huge fellows, being about five eighths of an inch long and three eighths of an inch broad, and would no doubt have killed the fish sooner or later. During the next two days no more fish were lost. They appeared strong and lively until early in the morning of our arrival at Council Bluffs. I examined the cans, as had been our custom every few hours, and found the fish very lively in all the cans but one, in which were several dead fish. They were all taken out of the can and the water poured off, when at the bottom of the can was found a greenish-looking substance about the size of a lozenge, which would break like a piece of cheese. I think, perhaps, the fish may have nibbled from this mysterious substance and been poisoned. The next day, on drawing off the water from these fish and filtering it, there was found a soft, greenish, oozy matter, which may have passed through the fish. We could in no way account for this substance being in the can. From this can sixteen fish in all were lost before getting to Council Bluffs. On arriving at Council Bluffs the fish were left in charge of Mr. Marks to bring over to Omaha on the through train, while I crossed the river on the dummy train to make arrangements for our passes to San Francisco, and also get a requisition for ice at the stations between Omaha and Ogden. While waiting for the train to come along, Mr. Marks gave the fish a change of water from an artesian well. The water was clear and cold, appearing to be of the best quality. The fish soon showed signs of distress, and, with all the aeration he could give the water, ten of them died, and others were occasionally turning on their sides. Some said the water was alkaline; others said the water had been analyzed and no alkali was found. Artesian water is almost destitute of air. I have known carp, after being in it a few minutes, to lie as if dead at the bottom of the can, and after an energetic aeration of the water would become lively again. As soon as the train got over to Omaha, a change of Missouri River water was given them, and with continual aeration they soon showed signs of improvement. In Omaha twenty-five fish were thrown out dead, and during the next eighteen hours thirty-three more died, making the loss of bass, from the time of first putting them into the cans, about one hundred and forty. While at Omaha, I felt that we would be fortunate if we could keep any of the fish alive during the remaining five days of the journey, as, on putting the arm down into the roily water, the fish seemed to be either on their sides at the bottom of the cans or so sick that they would make no effort to escape from the hand. During the remainder of the journey of about three and one half days no more fish were lost; and, although this was the most dangerous part of the trip, on account of the alkaline water at most of the stations, the fish kept in splendid condition all the way through.

I desire here to express my deep sense of obligation to the General Manager of the Union Pacific Railroad at Omaha for his very generous act in furnishing free transportation for the fish over his road, and also for other personal favors extended. The success of our undertaking was largely due to the uniform courtesy of the railroad officials along the entire route.

The striped bass, a little over three hundred in number, were placed in brackish water at 61° Fahrenheit, at Army Point, in Suisun Bay. Mr. B. B. Redding met us at that place and assisted in depositing them into the water.

The water in the Shrewsbury River is brackish, indicating on the salinometer four degrees density. Taking this brackish water with us on the start, Turk Island salt was added to fresh water until about four degrees density, when we renewed the water in the cans. During the first night the salinometer was accidentally broken, and afterwards we had to salt the water to our taste. By some misunderstanding the quantity of salt taken from Red Bank was not what had been intended, and the supply getting short the water gradually became fresh again. In this condition the fish remained twenty days or more. But they seemed to do equally well in either fresh or brackish water. Mr. Marks took great interest in making the enterprise a success, working very faithfully, and cheerfully submitting to the inconvenience of obtaining sleep by short naps across the trunks in the baggage-car, so that we could relieve each other every two hours, and thus give the bass that almost constant attention they required. For aerating the water, which was done every fifteen to twenty minutes, we used an implement contrived by Mr. Munroe Green, of Mumford, New York. This was a cylinder about eighteen inches in length and six in diameter, having the bottom perforated with fine holes, and the top with a lid, and a handle to manipulate it. By letting it fill as it was slowly pushed nearly to the bottom, and then quickly pulling it to the top of the can, it gave it a fine shower of about one and a half gallons of almost perfectly aerated water. By having ice inside this aerator during the operation, we found it admirably adapted for quickly cooling the water. This is just the thing where small fish are being carried, thus avoiding the danger of crushing them by having loose ice in the can. This aerator gave better satisfaction than any other ever used by me.

Very respectfully,

J. G. WOODBURY.

CARP.

There has sprung up throughout the State an active interest in the cultivation of the carp, and the Commission has done everything in its power to meet the wishes of those embarking in the business. We are most opportunely aided just at this time by the generous expenditure and active efforts of the United States Fish Commissioner in sending to this coast a special car with a full corps of experts in charge of a large shipment of carp for distribution on this coast, and it gratifies us to be able to say that the arrangements for supplying persons desirous of cultivating and propagating this valuable fish are now in successful operation. The cultivation and propagation of this useful fish seem as yet scarcely understood by many who are disposed to embark in it. The carp is, in fact, to a great extent, a domesticated fish. It requires care and attention, and a proper preparation of conditions artificially. In fact, we are yet to be educated to the successful and cheap mode of propagating them. This will all come with time, and time only will bring it about, and no extravagant expenditure of money will very much hasten the result.

SHAD.

Since our last report we have received from the United States Fish Commissioner two hundred and twenty thousand eastern shad, which were placed in the Sacramento River above Tehama. These fish have doubtless added to the already increasing stock of shad on this coast, and we may now fairly congratulate ourselves upon the establishing of shad as an existing fact. They are now a food fish ready for consumption, and require the protection of the law.

There seems to have been some misinformation in regard to the proper season of taking them, on the part of some persons who have attempted to make laws for their protection.

The Commission has taken pains to correspond with Mr. Seth Green and the Commissions on the eastern coast, and find that the "close season" for shad on this coast should be from June fifteenth to March first, thus making the open season—during which it may be lawful to take them—from March first to June fifteenth in each year; and in addition, the taking should be forbidden at all times from Saturday night to Monday morning.

In presenting this report we must be allowed to state that it is, in some respects, the records of what may be called unfinished business. There is a great deal of matter before the Commission requiring immediate care and attention. The hatching and distributing season is at hand. We have in course of hatching five hundred thousand whitefish presented by the United States Fish Commissioner. These are to be distributed throughout the northern waters of the State.

The hatching and distribution of land-locked salmon and the distribution of carp will require much care and attention of the Commissioners.

In making up the account of receipts and disbursements, we have made, as usual, the close of the fiscal year the first of January. At that time the amount of cash on hand is chargeable with the outstanding amount of the cost of placing of four millions of salmon in the Sacramento River, the bill for which not having come to hand in time to be paid out of the funds on hand at that date. It will amount to the sum of two thousand dollars. This and the current expenses of the hatching-house, and distributions before us, will probably consume the balance of the funds of the Commission by the time the new appropriation will be available.

We hope that we need not now state that the Commissioners have practiced the closest economy in all the details of the business, but the work covers a great deal of ground and must be well and carefully conducted, and always by employés of knowledge and experience in the business. A whole hatching of eggs may be lost in a night, and carloads of fish may perish in a single hour of neglect or ignorance. The work must be done by those trained to it.

In closing this report it is proper to give some reason for the delay which has attended its delivery. In the death of our lamented associate, Mr. B. B. Redding, this Commission shares largely in the loss which the State and the cause of science, education, and development have suffered in the untimely passing away of this truly estimable gentleman. For more than twelve years he gave to the

Commission the fruits of his study and research, and to him, mainly, it is indebted for the standing it had attained amongst the similar associations of the United States.

The death of Mr. W. W. Traylor, soon after his appointment, deprived us of a colleague who bid fair to make an attentive and valuable officer; and the other vacancy, caused by the resignation of Mr. J. D. Farwell, one of the earliest and most useful appointees, have contributed to retard the bringing up to date the affairs of the Commission with more dispatch.

RECEIPTS AND EXPENDITURES.

The following is an account of receipts and expenditures since our last report:

Receipts.

January 3, 1881—By cash on hand, as per last report	$4,258 55
November 3, 1881—By cash returned from A. W. Von Schmidt	95 00
January 31, 1882—By cash appropriation	5,000 00
January 31, 1882—By cash Pit River fish ladder	70 50
May 16, 1882—By cash returned freight carp	12 00
July 20, 1882—By cash State appropriation	5,000 00
	$14,436 05

Expenditures.

January 14, 1881—To paid Woodbury	$20 00
January 15, 1881—To paid Marks	80 00
January 21, 1881—To paid Wells, Fargo & Co.'s Express on 250,000 whitefish eggs	16 70
January 27, 1881—To paid W. N. Lockington, trip to Sacramento and reading proof of report	26 00
January 31, 1881—To paid Lockington balance expense proof at Sacramento	24 00
February 1, 1881—To paid expressage on 100,000 whitefish eggs	16 50
February 1, 1881—To paid stove and pipe for hatching house	7 65
February 1, 1881—To paid copper, lock, shingles	1 90
February 1, 1881—To paid flannel	3 10
February 1, 1881—To paid staples and files	50
February 1, 1881—To paid Woodbury, balance labor, January	130 00
February 3, 1881—To paid telegram, Michigan and Tulare	3 50
February 11, 1881—To paid Richardson, expense of 100,000 whitefish in Donner Lake, and 10,000 in Presidio Lake	43 50
February 11, 1881—To paid expressage on 250,000 whitefish eggs, Michigan	38 55
February 11, 1881—To paid drayage	1 00
February 15, 1881—To paid telegrams, Washington and Michigan	5 40
February 15, 1881—To paid Richardson, one month's labor, January	100 00
February 15, 1881—To paid expressage on 100,000 whitefish, Donner Lake	40 25
February 24, 1881—To paid postage stamps	5 00
February 24, 1881—To paid expressage	50
March 8, 1881—To paid Hoehn & Co. money advanced for purchase of catfish; expressage on cans and fish, Lathrop and Alameda	43 85
March 8, 1881—To paid Woodbury one month's labor	150 00
March 8, 1881—To paid food for fish	40
March 13, 1881—To paid Wells, Fargo & Co. expressage on whitefish eggs and trout eggs	26 05
March 13, 1881—To paid telegram, Watsonville, etc.	2 25
March 15, 1881—To paid expense of trout, etc., to Alpine County	38 30
March 15, 1881—To paid telegram, Woodbury	50
March 24, 1881—To paid Stratton expressage on cans and fish	9 50
March 24, 1881—To paid expense of distributing trout, etc., Gilroy	4 30
March 24, 1881—To paid same, Tahoe	53 31
March 24, 1881—To paid two telegrams, Visalia	2 00
April 4, 1881—To paid Henry Pither, 100 catfish, San Mateo, and expressage	11 75
April 4, 1881—To paid 500 small catfish, San Diego	12 40
April 4, 1881—To paid 162 catfish, Alpine	16 00
April 4, 1881—To paid Richardson, two months' and four days' labor	212 00
April 6, 1881—To paid Richardson, expressage on trout to Tehachapi	39 05
April 6, 1881—To paid Richardson, L. L. salmon, San Mateo	3 24
April 6, 1881—To paid telegrams	1 00
April 8, 1881—To paid Woodbury, labor, one month to April 1	150 00
April 8, 1881—To paid milk, feed trout	1 25
April 8, 1881—To paid W. J. Stratton, expressage and drayage	6 50
April 8, 1881—To paid 425 pounds ice	9 25

April 13, 1881—To paid Dunn, expense of trout to Sonoma	$5 50
April 18, 1881—To paid Woodbury, in full for labor to the 15th	75 00
April 18, 1881—To paid telegram	70
April 18, 1881—To paid Stratton, expressage on cans	6 50
April 18, 1881—To paid feed for trout	1 60
April 18, 1881—To paid Wells, Fargo & Co., expressage on cans	1 95
May 3, 1881—To paid expressage on cans	2 80
June 23, 1881—To paid telegrams, Professor Baird	3 55
June 27, 1881—To paid John Merryman, witness in Chinese case at San Rafael	20 00
July 28, 1881—To paid H. C. Marks, services clerk account, 1881	100 00
August 16, 1881—To paid expenses of Johnson, witness in Chinese case at San Rafael	10 00
August 16, 1881—To paid self	1 75
August 8, 1881—To paid Neville & Co., seine for carp, sixty feet	35 00
August 8, 1881—To paid Woodbury, expenses of transporting carp from Alameda to Redwood	36 30
August 12, 1881—To paid Pither, 250 catfish, Walsh, Cloverdale	6 25
August 12, 1881—To paid Pither, 500 catfish, Radcliff, Watsonville	11 25
August 12, 1881—To paid Pither, 500 catfish, A. Benson, Beowawe	18 25
August 12, 1881—To paid Pither, 500 catfish, Morland, Healdsburg	14 00
August 12, 1881—To paid Pither, 400 catfish, Weller, Cascades	15 00
August 12, 1881—To paid 500 catfish, Weller, Cascades	13 50
August 28, 1881—To paid expressage on cans	1 50
August 28, 1881—To paid Woodbridge one month's salary to 22d	150 00
September 1, 1881—To paid L. Levy, witness in People vs. Blencke	10 50
September 4, 1881—To paid expenses in examination of Pit River fishway	70 50
September 22, 1881—To paid J. Caire, wire cloth	5 76
September 22, 1881—To paid freight on 200,000 salmon eggs	16 00
October 1, 1881—To paid freight on 200,000 salmon eggs	7 50
October 15, 1881—To paid Captain Farwell for removing obstruction in Alameda Creek	5 00
October 24, 1881—To paid telegram, Professor Baird, whitefish	2 00
October 24, 1881—To paid Sturtevant & Gray, food for carp	2 45
October 24, 1881—To paid flannel for screen	2 10
October 24, 1881—To paid copper wire	1 35
October 24, 1881—To paid Stratton, expressage	2 00
October 24, 1881—To paid tacks and fare	2 10
October 24, 1881—To paid Woodbury, salary to October 19	150 00
November 3, 1881—To paid Horton, transporting 20,000 salmon, Donner Lake	20 00
November 21, 1881—To paid W. G. Gifford, labor and expenses at hatchery, and distribution of salmon	54 70
November 21, 1881—To paid tin pipe and work	2 50
November 21, 1881—To paid steel, Pacific Saw Factory	2 00
November 21, 1881—To paid thermometer, salt, brush	1 25
November 21, 1881—To paid labor, drawing carp pond	2 25
November 21, 1881—To paid galvanized wire	2 53
November 21, 1881—To paid Stratton, express transportation of salmon	12 00
November 21, 1881—To paid Woodbury, one month, four days	170 00
November 21, 1881—To paid expenses and fare, Gifford, distributing salmon	23 85
November 26, 1881—To paid H. D. Dunn, distributing salmon, Pescadero, Redwood, and Russian River	10 00
November 29, 1881—To paid H. Pither, catfish, Sierra Valley and Monterey	41 50
December 3, 1881—To paid E. F. Preston, attorney for Superior Court, Hey Sing Yet vs. Anderson	105 40
December 8, 1881—To paid bill for ice, transporting fish	4 00
December 13, 1881—To paid Wells, Fargo & Co., transporting cans	2 50
December 19, 1881—To paid Wells, Fargo & Co., freight, trout eggs, New Hampshire	11 55
December 31, 1881—To paid L. Stone, 30,000 Eastern trout eggs	120 00
December 31, 1881—To paid packing	3 25
December 31, 1881—To paid draft	35
January 1, 1882—To paid Woodbury, labor half month to date	75 00
January 1, 1882—To paid Woodbury, expense to Taylorsville, fish-ladder	6 60
January 1, 1882—To paid Stratton, express, fish eggs	3 00
January 3, 1882—To paid Wells, Fargo & Co., express, whitefish eggs	52 80
January 31, 1882—To paid L. Stone, for hatching 2,000,000 salmon	1,000 00
February 2, 1882—To paid express, 250,000 whitefish eggs, Michigan	28 00
February 2, 1882—To paid Mullen, to San Leandro for fish	2 00
February 8, 1882—To paid half month labor to January 15	50 00
February 13, 1882—To paid Knowles & Co., syphon and aerator	2 75
February 13, 1882—To paid Stratton, express, fish and cans to January 13	11 50
February 13, 1882—To paid Woodbury, expenses with carp to Stockton	9 55
February 13, 1882—To paid Woodbury, labor one month to February 1	150 00

February 13, 1882—To paid J. Caire, wire cloth	$4 08
February 13, 1882—To paid Richardson, half month labor to February 1	50 00
February 13, 1882—To paid Palmer & Sons, 50,000 Eastern trout	125 00
February 13, 1882—To paid Pither, 500 catfish and express	14 50
February 15, 1882—To paid draft, Palmer Sons	50
February 15, 1882—To paid Wells, Fargo & Co., transporting trout and whitefish	35 55
February 15, 1882—To paid Wells, Fargo & Co., transporting trout and whitefish	40
February 23, 1882—To paid express, transporting 1,000 whitefish, Clear Lake	46 10
February 23, 1882—To paid 80,000 whitefish, Donner Lake	51 30
February 23, 1882—To paid 60,000 whitefish, Clear Lake	31 55
March 2, 1882—To paid dispatch, Carson	75
March 2, 1882—To paid express	50
March 3, 1882—To paid J. B. Campbell, 15,000 trout eggs	60 00
March 6, 1882—To paid Stratton, express, trout eggs	3 00
March 6, 1882—To paid express, Mullen, 50 cents; transporting trout, Monterey, $3 85	4 35
March 6, 1882—To paid sheet tin, $1; Woodbury, labor one month, $1 50	150 00
March 10, 1882—To paid Wells, Fargo & Co., L. L. salmon eggs, Maine	10 20
March 10, 1882—To paid Wells, Fargo & Co., San Leandro	1 00
March 10, 1882—To paid telegram, Boca	50
March 10, 1882—To paid shrimps, etc., fish food, $2 50; messenger, 50 cents	3 00
March 26, 1882—To paid Woodbury, account	20 00
April 3, 1882—To paid Stratton, Whitefield and L. L. salmon expressage to cars	4 00
April 3, 1882—To paid drawing carp pond labor	2 50
April 3, 1882—To paid Woodbury, balance labor, March	130 00
April 3, 1882—To paid drayage	60
April 9, 1882—To paid McDonald, trout, Prosser Creek	3 75
April 15, 1882—To paid Wells, Fargo & Co., expressage on fish cans	3 90
April 15, 1882—To paid drayage on cans, etc.	2 00
April 15, 1882—To paid Richardson, labor, February seventeenth	100 00
April 21, 1882—To paid March first, expressage and labor for transportation of 100,000 whitefish to Tahoe via Carson, and 10,000 Eastern trout, and distributing in Truckee, Little Truckee, P. Creek, D. Lake, S. Valley and Cisco	60 55
April 21, 1882—To paid April seventh, transportation of 3,000 L. L. salmon and 6,000 Eastern trout to P. Creek and Truckee, and 1,500 Eastern trout and 1,500 California trout to Nevada	33 70
April 21, 1882—To paid April seventeenth, transportation of 4,500 Eastern trout, 2,500 L. L. salmon, Blue Lakes, Lake County	10 40
April 21, 1882—Richardson, labor, one month	100 00
May 1, 1882—To paid Woodbury, expressage, fare, and telegram	3 85
May 1, 1882—Fare to Watsonville	2 90
May 1, 1882—Fish food	2 00
May 1, 1882—Woodbury, labor, one month	150 00
May 1, 1882—Stratton, expressage on fish cans	8 00
May 3, 1882—To paid Hoehn, ice	2 34
May 12, 1882—To paid Wells, Fargo & Co., distributing carp	44 25
May 15, 1882—To paid telegram	50
May 16, 1882—To paid fare and expense Taylorsville fish-ladder	3 20
May 16, 1882—To paid Richardson, labor for April	100 00
May 16, 1882—To paid fares to San José and San Leandro	4 10
May 20, 1882—To paid telegram, Sacramento	60
May 24, 1882—To paid bill of ice for fish	12 55
May 25, 1882—To paid H. C. Marks, labor copying notices, writing letters, etc.	50 00
May 25, 1882—To paid Woodbury, labor	50 00
May 25, 1882—To paid telegram	50
June 1, 1882—To paid feed for fish, fare to San José, etc.	8 15
June 1, 1882—To paid Woodbury, balance for labor for May	100 00
June 1, 1882—To paid turpentine, wire cloth, etc.	4 81
June 1, 1882—To paid Stratton, expressage, $9; Wells, Fargo & Co., $2 55	11 55
June 1, 1882—To paid expense Taylor trial, San Rafael	4 60
June 7, 1882—To paid Richardson, labor one month and five days, to June fifth	119 00
June 7, 1882—To paid fare, expressage on 15,000 Eastern trout to south fork of Yuba and north fork of American	32 95
June 8, 1882—To paid telegram, Woodbury	1 00
June 12, 1882—To paid Woodbury, ten days' labor, July	50 00
June 12, 1882—To paid for distributing fish, $3 25; Stratton, expressage, $3	6 25
June 12, 1882—To paid two telegrams	1 50
July 21, 1882—To paid Pither, catfish M. Gray, San Diego and Arizona	12 50
July 21, 1882—To paid, 1,000, Farwell, Alameda	24 50
July 21, 1882—To paid to H. C. Marks, labor copying, writing, etc.	50 00
June 14, 1882—To paid expense suit People vs. Taylor	2 00
June 14, 1882—To paid Wells, Fargo & Co., expressage on eggs from Redding	7 70

June 14, 1882—To paid Woodbury, account of striped bass from New Jersey		$800 00
June 14, 1882—To paid S. I. Co., bill ice		2 25
July 23, 1882—To paid telegram, Woodbury		1 50
July 23, 1882—To paid telegram, Woodbury		25
July 23, 1882—To paid telegram, Throckmorton		45
July 23, 1882—To paid drayage labor, striped bass		2 10
July 26, 1882—To paid Woodbury, account of expressage on striped bass		80 00
July 26, 1882—To paid Woodbury, account of expressage on striped bass		60 00
July 29, 1882—To paid Woodbury, balance expense of $946 47, for transportation of striped bass		6 47
July 29, 1882—To paid Stratton, expressage on cans		2 00
July 31, 1882—To paid H. C. Marks, labor to July first		50 00
August 4, 1882—To paid W. A. Gift, expenses of arrest, People vs. J. Benson		25 00
August 13, 1882—To paid Hoehn, ice, May third		2 34
August 13, 1882—To paid Hoehn, ice, June twenty-third		2 25
December 5, 1882—Bill of Stafford & Dugan, for horse and buggy to fish pond, and carp		3 00
December 5, 1882—Bill of Tubbs & Co., piece 1¾ Manila rope		4 00
December 5, 1882—Bill of Thomas Driver, one can paint		60
December 5, 1882—Bill of H. C. Marks, clerical services		50 00
December 5, 1882—Bill of Wengola, for material and work on seine, 180 feet long		35 50
December 5, 1882—Bill of Armes & Dallam, forty-one pounds of netting		32 80
December 5, 1882—Bill of George R. Jackson, for services in making statistics of salmon, sturgeon, etc., transported to San Francisco, Sacramento, and Stockton, September 1, 1880, to August 1, 1882		67 50
December 5, 1882—Bill of J. G. Woodbury:		
August third, express charges to Washington	$ 60	
August twenty-second, fare to Oakland	90	
August twenty-fifth, fare to San Leandro	50	
August thirtieth, fare to Redwood City	50	
October twenty-sixth, fare to San Leandro	80	
Shipping tags	10	
November first, services for one third of a month	50 00	
		54 75
December 5, 1882—Bill of J. G. Woodbury:		
November eighteenth and nineteenth, fare to San Leandro	$ 50	
Hotel expenses	50	
November twenty-third, Fare to San Leandro	80	
November twenty-seventh, fare to Redwood City	1 85	
November twenty-seventh, stage fare to Burr's pond	75	
November twenty-seventh, expressage on seine	1 00	
November twenty-seventh, freight, cans, etc.	1 00	
December first, services, November 18 to December 1	60 00	
		66 40
December 7, 1882—Freight on fish cans		1 35
January 3, 1883—Bill of J. G. Woodbury:		
December twenty-fourth, cash for staples for baskets	$ 30	
January first, salary for one half month to date	75 00	
		75 30
January 3, 1883—Bill of A. D. Oakley:		
One stencil	$ 1 45	
One set tags	75	
Ink and brush	50	
		2 70
January 3, 1883—Bill of E. M. Derby & Co., for lumber		10 13
January 3, 1883—Bill of C. H. Gray, brush, nails, etc		1 10
January 3, 1883—Bill of Thomas Driver, one dining table		3 75
January 3, 1883—Bill of Smalley & Stratton, for hauling		4 00
January 3, 1883—Bill of California Wire Works		5 04
January 3, 1883—Bill of Cunningham, Curtiss & Welch, stationery		4 25
January 3, 1883—Bill for telegrams		15 30
January 3, 1883—Expressage on fish cans		6 00
		$7,559 51
Cash on hand to balance		6,876 54
		$14,436 05

The balance on hand of $6,876 54 stands charged with the outstanding amount of $2,000, payable for placing four millions of salmon in the Sacramento River, as before stated, after which the remaining

$4,876 54 will be required and consumed in distributing the productions of the State Hatchery throughout the State, and the importation of Eastern fish.

S. R. THROCKMORTON,
Chairman of Fish Commission.

APPENDIX "A."

Memorandum Statement, showing Fresh Salmon received at San Francisco from September 1, 1880, *to August* 1, 1882.

	Boxes.	Loose.
1880—September	997	20,244
October	621	8,560
November	118	3,369
December	150	9,621
	1,886	41,794
Boxes will average eight fish per box; total, 56,882 fish. Estimated at 13 pounds each, or say in season, 739,466 pounds.		
1881—January	140	4,210
February	114	5,823
March	138	6,431
April	2,965	25,391
May	5,384	10,383
June	1,939	2,414
July	993	3,813
September	10,054	60,853
October	1,526	2,932
November	443	1,086
December	577	2,906
	24,273	126,242
Total, 320,426 fish; estimated at 13 pounds each, or say in season, 4,165,538 pounds.		
1882—January	579	2,734
February	341	4,746
March	853	16,576
April	2,238	9,708
May	2,967	2,247
June	1,608	1,876
July	1,585	5,128
	10,171	43,015
Total	36,320	211,051
Total, 124,383 fish; estimated at 13 pounds each, or say in season, 1,616,979 pounds.		
Grand total, 501,691 fish.		

Memorandum Statement, showing amount of Fresh Salmon received at Sacramento from September 1, 1880, *to August* 1, 1882.

	Loose.	Boxes.
1880—September	203	2
October		7
November	184	4
December	635	1
	1,022	14
Total, 1,134 fish; estimated at 13 pounds each, or say in season, 14,742 pounds.		
1881—January	107	3
February	42	65
March	143	50
April	100	53
May		10
June		
July		
August		
September		
October		18
November	34	49
December	92	39
	518	287
Total, 2,814 fish; estimated at 13 pounds each, or say in season, 36,582 pounds.		
1882—January	39	49
February	64	28
March	168	136
April	83	73
May	103	776
June		214
July	130	
	579	1,276
Total, 10,777 fish; estimated at 13 pounds each, or say in season, 140,101 pounds.		

Memorandum Statement, showing amount of Fresh Sturgeon received at San Francisco from September 1, 1880, *to August* 1, 1882.

1880—September	588
October	237
November	160
December	433
Total	1,418
Estimated at 50 pounds each, or say in season, 70,900 pounds.	
1881—January	185
February	315
March	320
April	870
May	453
June	172
July	214
August	1,809
September	606
October	186
November	220
December	171
Total	5,821
Estimated at 50 pounds each, or say in season, 291,050 pounds.	

1882—January	146
February	356
March	846
April	409
May	70
June	102
July	875
August	2,230
Total	5,034

Estimated at 50 pounds each, or say in season, 251,700 pounds.

Memorandum Statement showing Miscellaneous Receipts of Fish as under at San Francisco from September, 1880, *to August,* 1882.

	Baskets.	Barrels.	Mats.	Sacks.
1880—September	21	36	1	8
October	25	3	1	41
November	45	21	------	33
December	200	------	------	46
	291	60	2	128
26 boxes smoked salmon, 9,000 pounds.				
1881—January	180	61	------	31
February	251	9	------	4
March	84	20	------	1
April	22	16	------	3
May	9	9	------	------
June	14	6	------	16
July	4	10	------	------
August	4	14	------	------
September	31	43	------	354
October	20	14	------	4
November	66	33	------	18
December	201	26	------	20
	886	261	------	451
11 boxes smoked salmon, 3,500 pounds.				
1882—January	84	5	------	5
February	65	6	------	1
March	169	45	------	22
April	27	32	------	9
May	12	1	------	------
June	9	3	------	2
July	3	18	------	------
	369	110	------	39
Totals	1,546	431	2	618

Barrels are dried fish, and weigh 200 pounds each. Sacks are small fresh fish, and weigh 75 pounds each. Baskets are China and contain both fresh and cured fish, and weigh 100 pounds each.

DISTRIBUTION OF FISH.

January 31, 1880—500 catfish sent to J. B. Still, for Eel, Salt, and Mad Rivers, Humboldt County, California.
February 7, 1880—15,000 Eastern trout, placed by Richardson in Merced and Yosemite.
February 20, 1880—300 catfish sent to J. E. Still, Eureka, Humboldt County.
March 19, 1880—1,000 Eastern trout sent to Almshouse Pond, San Francisco, California.
March 20, 1880—2,000 Eastern trout sent to Donner Lake outlet.

March 20, 1880—6,000 Eastern trout sent to Independence Lake and Little Truckee.
March 20, 1880—8,000 Eastern trout sent to South Yuba, Truckee.
March 29, 1880—500 Eastern trout sent to Woodward's Gardens.
April 2, 1880—1,000 Eastern trout sent to Laguinetas Creek, Marin.
April 7, 1880—2,000 McCloud River trout sent to Laguinetas Creek, Marin.
April 4, 1880—2,000 Eastern trout, Soda Springs, South Yuba.
April 4, 1880—6,000 Eastern trout, Sierra Valley, Feather River.
April 12, 1880—10,000 McCloud River trout to Carmel, Monterey, Salinas Valley, and Santa Cruz streams.
April 28, 1880—10,000 McCloud River trout sent to Tuolumne and Merced (lost).
May 1, 1880—8,000 McCloud River trout sent to streams in San Mateo, Monterey, and Santa Cruz.
May 3, 1880—2,000 McCloud River trout sent to streams in Santa Clara.
June 7, 1880—500 catfish to Smith & Terry, for Stockton.
June 7, 1880—500 catfish to J. K. Vail, for Forbestown.
June 7, 1880—2,000 catfish to A. C. Bassett, for Monterey, Pajaro, etc.
June 7, 1880—500 catfish to J. W. Wright Johnson, for Bellota.
June 12, 1880—1,000 catfish to A. B. Carlock, for Siskiyou (lost).
June 21, 1880—500 catfish to J. C. Smith, for Stockton.
June 30, 1880—12 carp sent to Commissioner E. R. Calhoun, for Mare Island.
July 17, 1880—500 catfish to C. Brown, for Merced.
July 17, 1880—1,000 catfish to A. B. Carlock, for Siskiyou (lost).
July 21, 1880—500 catfish to J. H. Maynard, for San Mateo Creek.
August 2, 1880—500 catfish to W. McLaughlin, for Amador.
September 2, 1880—500 catfish (large) to S. B. Weller, Cascade Lakes, Placer.
October 21, 1880—500 catfish to E. R. Shinmin, for Eel River (Little Lake).
November 1, 1880—500 catfish to Charles Mansfield, Merced, for Sloughs, San Joaquin.
November 2, 1880—250 catfish to E. Steele, for Yreka.
January 24, 1881—100 catfish to Lux, for San Mateo County.
February 5, 1881—100,000 whitefish sent to Tulare Lake.
February 11, 1881—10,000 whitefish sent to United States Marine Hospital, Presidio.
February 12, 1881—10,000 whitefish sent to Lake Merced.
February 12, 1881—10,000 whitefish sent to lakes in Marin County.
February 16, 1881—100,000 whitefish deposited in Donner Lake.
February 21, 1881—500 catfish sent to Foster, for San Diego County.
March 2, 1881—4,000 landlocked salmon to Alpine County.
March 2, 1881—162 catfish to Alpine County.
March 16, 1881—1,000 McCloud River trout to E. H. Farmer, for Gilroy.
March 16, 1881—1,000 McCloud River trout to R. D. Arricks, for Gilroy Hot Springs.
March 16, 1881—1,000 McCloud River trout to W. R. Radcliff, for Santa Cruz.
March 16, 1881—1,000 landlocked salmon to W. R. Radcliff, for Santa Cruz.
March 16, 1881—1,000 McCloud River trout to H. S. Ball, for Salinas.
March 16, 1881—1,000 landlocked salmon to H. S. Ball, for Salinas.
March 16, 1881—200 catfish to D. Benson, Beowawe.
March 18, 1881—200 catfish to Dr. Webber, for Sierra Valley.
March 18, 1881—4,000 McCloud River trout to E. D. Parks, Sumner, Tehachapi.
March 18, 1881—3,000 McCloud River trout to R. A. Campbell, for Cisco.
March 18, 1881—3,000 McCloud River trout to J. B. Brogan, for Prosser Creek.
March 18, 1881—5,000 landlocked salmon to J. B. Campbell, for Tahoe City.
March 18, 1881—2,000 landlocked salmon to J. F. Moody, for Donner Lake.
March 18, 1881—4,000 landlocked salmon to J. B. Brogan, for Prosser Creek.
March 18, 1881—2,000 landlocked salmon to Colkins & Sons, for Nevada City.
March 25, 1881—300 landlocked salmon to Mt. View Lake, Presidio.
March 25, 1881—200 trout to Mt. View Lake, Presidio.
March 25, 1881—200 trout to Woodward's Gardens.
March 25, 1881—500 whitefish to Shafter, for Marin County.
March 25, 1881—100 landlocked salmon to Shafter, for Marin County.
March 25, 1881—200 trout to Shafter, for Marin County.
March 25, 1881—1,000 trout to E. P. Converse, for Tulare.
March 25, 1881—4,000 trout to E. D. Parks, Sumner, for Kern County.
April 4, 1881—200 landlocked salmon to San Mateo, San Andreas.
April 4, 1881—500 landlocked salmon to Mt. View Lake, San Francisco.
April 7, 1881—4,000 trout to Sonoma Creek.
October 27, 1881—20,000 salmon to San Leandro, Grass Valley, and creeks in Alameda.
November 2, 1881—10,000 salmon to Almshouse, San Francisco.
November 3, 1881—15,000 salmon to Pescadero Creek.
November 4, 1881—8,500 salmon to Petaluma Sportsmen's Club.
November 5, 1881—10,000 salmon for Prosser Creek and Truckee.
November 5, 1881—10,000 salmon for Donner Lake.
November 6, 1881—15,000 salmon for Russian River.
November 9, 1881—15,000 salmon for San Gregorio.
November 9, 1881—2,000 salmon for Woodward's Gardens.

November 14, 1881—15,000 salmon to Skaggs' Springs.
November 18, 1881—15,000 salmon to Santa Cruz and Monterey.
November 18, 1881—15,000 salmon to Salinas and Gilroy.
November 24, 1881—2,270,000 salmon deposited in McCloud, Pit, Sacramento Rivers, and Salt Creek.
November 26, 1881—500 catfish sent to Monterey.
November 26, 1881—1,000 catfish sent to Sierra Valley.
January 7, 1882—39 old carp, 32 young carp of 1881 spawn, deposited with W. L. Overheiser, Stockton, to be bred on shares.
February 10, 1882—500 catfish sent to C. Warfield, for Fresno.
December 16, 1882—Completed the placing of four millions of young salmon in the headwaters of the Sacramento River.

LIST OF FISH COMMISSIONERS.

DOMINION OF CANADA.

W. F. Whitcher, Commissioner	Ottawa, Ontario

PROVINCE OF NEW BRUNSWICK.

W. H. Venning, Inspector of Fisheries	St. John

PROVINCE OF NOVA SCOTIA.

W. H. Rogers, Inspector	Amherst

PROVINCE OF PRINCE EDWARD ISLAND.

J. H. Duvar, Inspector	Alberton

PROVINCE OF BRITISH COLUMBIA.

A. C. Anderson	Victoria

THE UNITED STATES.

Prof. Spencer F. Baird	Washington, District of Columbia

ALABAMA.

C. S. G. Doster	Prattville
D. B. Huntley	Courtland

ARIZONA.

John J. Gosper	Prescott
Richard Rule	Tombstone
Dr. J. H. Taggart, Business Manager	Yuma

ARKANSAS.

John E. Reardon	Little Rock
James H. Hornibrook	Little Rock
H. H. Rottaken	Little Rock

CALIFORNIA.

S. R. Throckmorton	San Francisco
A. B. Dibble	Grass Valley, Nevada County
B. H. Buckingham	Washington, Yolo

COLORADO.

Wilson E. Sisty	Idaho Springs

CONNECTICUT.

Dr. Wm. M. Hudson	Hartford
Robert G. Pike	Middletown
George N. Woodruff	Sherman

DELAWARE.

Enoch Moore, Jr.	Wilmington

GEORGIA.

J. T. Henderson, Commissioner of Agriculture, and ex officio Commissioner of Fish and Fisheries	Atlanta
Dr. H. H. Cary, Superintendent	La Grange

ILLINOIS.

N. K. Fairbank, President	Chicago
S. P. Bartlett	Quincy
S. P. McDoel	Aurora

INDIANA.

Calvin Fletcher	Spencer, Owen County

IOWA.

B. F. Shaw	Anamosa
A. A. Mosher, Assistant	Spirit Lake

KANSAS.

Hon. D. B. Long	Ellsworth

KENTUCKY.

William Griffith, President	Louisville
Hon. John A. Steele	Versailles
Dr. Wm. Van Antwerp	Mount Sterling
A. H. Goble	Catlettsburg
Hon. C. J. Walton	Munfordville
Dr. S. W. Coombs	Bowling Green
John B. Walker	Madisonville
P. H. Darby	Princeton
Hon. J. M. Chambers	Independence, Kenton County
W. C. Price	Danville

MAINE.

E. M. Stilwell	Bangor
Henry O. Stanley	Dixfield

MARYLAND.

Thomas Hughlett	Easton
G. W. Delawder	Oakland

MASSACHUSETTS.

E. A. Brackett	Winchester
Asa French	South Braintree
F. W. Putnam	Cambridge

MICHIGAN.

Eli R. Miller	Richland
A. J. Kellogg	Detroit
Dr. J. C. Parker	Grand Rapids

MINNESOTA.

First District—Daniel Cameron	La Crescent
Second District—Dr. Wm. M. Sweney	Red Wing
Third District—Dr. Robert Ormsby Sweeny	St. Paul

Fourth District—No appointment until January.
Fifth District—No appointment until January.

MISSOURI.

Dr. J. G. W. Steedman, Chairman	2803 Pine St., St. Louis
John Reid	Lexington, Lafayette County
Dr. J. S. Logan	St. Joseph

NEBRASKA.

W. L. May	Fremont
R. R. Livingston	Plattsmouth
B. E. B. Kennedy	Omaha

NEVADA.

Hon. Hubb G. Parker	Carson City

NEW HAMPSHIRE.

George W. Riddle	Manchester
Luther Hayes	Milton
Albina H. Powers	Grantham

NEW JERSEY.

Dr. Benjamin P. Howell	Woodbury
Major Edward J. Anderson	Trenton
Theodore Morford	Newton

NEW YORK.

Hon. R. Barnwell Roosevelt	76 Chambers St., New York
Edward M. Smith	Rochester
Richard U. Sherman	New Hartford, Oneida County
Eugene G. Blackford	Fulton Market, New York City; 809 Bedford Avenue, Brooklyn

NORTH CAROLINA.

S. G. Worth	Raleigh

OHIO.

Col. L. A. Harris, President	Cincinnati
Charles W. Bond, Treasurer	Toledo
Halsey C. Post, Secretary	Sandusky

PENNSYLVANIA.

Hon. H. J. Reeder	Easton
Hon. B. L. Hewit	Hollidaysburg
James Duffy	Marietta
John Hummel	Selingsgrove
Robert Dalzell	Pittsburg
G. M. Miller	Wilkesbarre

RHODE ISLAND.

Alfred A. Reed	Providence
Newton Dexter	Providence
John H. Barden	Rockland

SOUTH CAROLINA.

A. P. Butler, Commissioner of Agriculture and ex officio of Fish and Fisheries	Columbia
C. J. Huske, Superintendent	Columbia

TENNESSEE.

W. W. McDowell	Memphis
H. H. Sneed	Chattanooga
Edward D. Hicks	Nashville

TEXAS.

R. R. Robertson	Austin

UTAH.

No appointment since the death of Prof. J. L. Barfoot, in April last.

VERMONT.

Hiram A. Cutting	Lunenburg, Essex County
Herbert Brainerd	St. Albans

VIRGINIA.

Col. M. McDonald	Berryville

WEST VIRGINIA.

Henry B. Miller, President	Wheeling
C. S. White, Secretary	Romney
N. M. Lowry	Hinton

WISCONSIN.

The Governor, ex officio	Madison
Philo Dunning, President	Madison
C. L. Valentine, Secretary and Treasurer	Janesville
J. V. Jones	Oshkosh
John F. Antisdel	Milwaukee
Mark Douglas	Melrose
Christopher Hutchinson	Beetown

WYOMING TERRITORY.

Dr. M. C. Barkwell, Chairman and Superintendent	Cheyenne
Otto Gramm, Secretary	Laramie
Hon. N. L. Andrews	Johnson County
Hon. E. W. Bennet	Carbon County
Hon. P. J. Downs	Uinta County
Hon. T. W. Quinn	Sweetwater County

REPORT

OF THE

COMMISSIONERS OF FISHERIES

FOR THE

STATE OF CALIFORNIA,

FOR THE

YEARS 1883-4.

COMMISSIONERS OF FISHERIES.

A. B. DIBBLE, Grass Valley, Secretary and Treasurer.
R. H. BUCKINGHAM, Sacramento, President.
J. D. REDDING, San Francisco.

Fish & Game Commission
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SAN FRANCISCO, CALIF.

SACRAMENTO:
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STATE OFFICE....... JAMES J. AYERS, SUPT. STATE PRINTING.
1884.

REPORT.

To his Excellency George Stoneman, *Governor of California:*

The Commissioners of Fisheries for the State of California, appointed under an Act of the Legislature, entitled "an Act to provide for the restoration and preservation of fish in the waters of the State," approved April 2, 1870, respectfully submit their eighth biennial report.

SALMON.

This most important of our inland water fish is in great demand, not only by all our citizens for table consumption, but also by the numerous canneries, some twenty-one in number, situated on the banks of the Sacramento, the bays, and in San Francisco, having increased their business in the last few years to large proportions. The average pack now is about 200,000 cases per annum. The boats employed in 1883, in taking salmon, were about 1,200, and are increasing in number. The average catch to each boat is about 1,500 fish, weighing about 21,600,000 pounds, per annum.

The increase of catch for the last three years caused a marked decrease in the supply for the year 1883, with a chance of a more marked decrease for the year 1884, the causes of which are many, viz.:

First—Illicit fishing done during the close season.

Second—Loss of salmon in the tules.

Third—The consumption by seals and sea-lions, which are very destructive to salmon and other fish. They follow the fish from the Golden Gate to Rio Vista.

Fourth—The different kinds of aquatic birds, which are very numerous, and very destructive to the young of all kinds of fish as they are descending from the spawning grounds to the ocean.

Fifth—Dams and other obstructions near their spawning grounds.

These are the principal difficulties over which the Commissioners have no control, except as to the first.

THE VIOLATORS OF THE LAW.

The Commissioners have exercised their power to abate the evil of illicit fishing, but owing to the limited means at their command, they have been unable to do all that was required to be done. There has been in that direction a great amount of work performed, in different parts of the State, the most of which was done on the lower Sacramento and San Joaquin Rivers, and the bays of Suisun, San Pablo, and San Francisco.

During the close season of 1883 the Commission placed a patrol upon the rivers and bays, which has had a very wholesome effect.

Mr. W. C. Jones, the Deputy Commissioner, had charge of the patrolmen employed, and did good service, as his annexed report shows.

The marked increase of salmon caught in the last few years is on account of the demand from the canneries. During the heavy run in former years, the fishermen did not work more than one third of the time. The canneries take the most of the catch from the first of April to the fifteenth of July, and from the first of September to the middle of October. The fishermen work most of the time, say eighteen hours of the twenty-four.

It is necessary for the Commission to plant as many young salmon as can be procured, at the headwaters of the Sacramento, in order to keep up the supply. Owing to the breaking of the waterwheel of the United States hatchery on the McCloud River, and to other causes, the supply of young fish was cut short in the year 1883 more than 3,000,000. It will be necessary for the California Commissioners to plant not less than 4,000,000 young fish each year, in order to meet the heavy drain continually going on.

The present Commission has used considerable exertion against the violators of the fish laws, but unless some stringent legislation is obtained, our streams and bays will soon be without a needful supply of salmon and other fish.

The large demands that came from the packing houses in the year 1883, caused an unusual amount of fish to be taken. During this season, which has been an unusually short one, the amount of fresh salmon, which has been packed, amounts to 451,957 Spring salmon, and 160,542 Fall salmon, aggregating 7,349,998 pounds. The amount of fresh Spring salmon sold in the markets was 115,004, and of Fall run 52,902, aggregating 2,235,684 pounds; total number of pounds sold and canned in the year 1883, 9,585,672 pounds. These statistics do not include 60,000 or more caught above Sacramento City. In order to meet this immense drain, it will be necessary to have at least one hatching house belonging to the State on the Little Sacramento, or the McCloud, or Pit Rivers.

From the fifteenth day of October, 1883, until the first day of January, 1884, the run of salmon was very good, and especially in the month of January, as there were more caught during that month of what is termed the Winter run, than in years past. The cause was probably on account of the stage of the river, which was extremely low for that season of the year. The Spring run was retarded in consequence of the low water, and no considerable amount of fish was caught until after the twentieth of March. The outlook for a heavy run early in the season was not promising, there being less fish observed outside the Bay of San Francisco than for a number of years preceding.

The decrease of salmon in the McCloud River, in 1883, was caused by the continual blasting on the line of the Northern Pacific Railroad, above Redding; this caused the fish to stop below the United States hatchery, at Bairds, only allowing very few fish to ascend to their spawning grounds. It was a cause that could not be avoided.

Mr. Livingstone Stone, the Deputy United States Fish Commissioner for this coast, did all in his power to catch as many fish as would fill his contract with the Commissioners of this State (4,000,000), but did not succeed by about 3,000,000. The Commissioners desire not less than 4,000,000 each year in order to keep up the supply and to increase the number. The demand is increasing every year, and, unless the number of young fish can be increased, our run of salmon will be less every year. In the year 1883 there were caught not less than 300,000 more than the Commission planted. A considerable number of salmon spawn in different streams, quite a large proportion running into the Sacramento and San Joaquin Rivers; and, in fact, we feel assured that most of the Fall run of salmon never reach the McCloud, but deposit their ova upon the bars between Colusa and Red Bluff.

EIGHTEEN HUNDRED AND EIGHTY-FOUR.

The run of salmon during this year has been very late. The Spring run was very light up to and after the first of April. During the month of April the run started in with a small catch, and remained so until the first of May, when a small increase was noticed for about two weeks; then the run slacked, and by the middle of May the fish were very scarce, and continued scarce all through May, resulting in the smallest take in a number of years.

The June run, which in ordinary years has been the heaviest, resulted in a very small showing; a heavy decrease for the Spring run.

The causes for the scarcity of salmon for the year 1884 are several, viz.:

First—The loss of fish in the tules in the years 1881 and 1882.

Second—The using of small mesh nets from 1877 up to 1883, and the increase of seines at or near the spawning grounds. The increase of nets used in the bays leading to the river has also caused a great decrease. The river is at times apparently completely dammed by nets.

The pack of salmon on the Sacramento for the year 1884 will fall short fully one half from that of the year 1883, although more than ordinary exertions have been made by the fishermen to obtain them.

The Commissioners in their report of 1878–9 predicted a heavy run of fish in the Sacramento River for the years 1883 and 1884, but, for the various causes mentioned, their predictions have not been fulfilled.

The Fall run of salmon of 1884 has been the lightest that was ever known in the memory of the oldest fisherman. On the first and second days of September the run was not as heavy as it should have been during the same days in the month of October. There is no cause known to the Commission for the marked decrease in the Fall run this year, as the Fall fish have invariably taken care of themselves.

EASTERN SALMON.

These are a different species and are entirely unknown to the Pacific Coast. They inhabit the waters north of the forty-first degree of latitude, and are never seen south of that degree. They are caught in great numbers as high north as the coast of Norway.

The California, or Chinook, are taken in lower degrees of latitude than any other kind of salmon, and run down as low as thirty-seven degrees north, which we believe is as low as they are ever caught. This is occasioned by the temperature of the water, which in some seasons of the year reaches as high as eighty degrees Fahrenheit.

At the time when the fish are seeking their river spawning grounds they begin to fail in quality as food (although they are used by a great many), and large numbers are secured just before spawning, by fishermen and others, on the upper waters of the rivers. Numbers of fishermen have been known to catch and sell salmon immediately after spawning and upon the spawning grounds, when the fish were wholly unfit for human food. This grievous evil, in our opinion, should be prohibited by very stringent laws.

TRUCKEE TROUT.

Of this species of fish, most are taken in the State of Nevada, on account of the various dams in that State, which are constructed in such form that it is impossible for trout to raise over them. Unless the State of Nevada does something towards dam abatement, the Truckee River trout will be a fish of the past in a very short time. Although the citizens of Nevada stoutly deny this fact, it appears strange that no trout are caught above the Nevada State line, when in former years they were abundant the whole length of the river from Pyramid Lake to Lake Tahoe.

Commissioner Dibble visited several of the dams in the State of Nevada, and in his report, before the meeting of the Board held on the fourteenth day of April, 1884, he stated that the statements of the mill owners on that portion of the river in California were correct, in that it was impossible for trout to ascend the Truckee above Foulkes' Dam, near Verdi, in the State of Nevada.

LAND-LOCKED SALMON.

The Commission received from Mr. Atkins, Deputy United States Fish Commissioner at Bucksport, State of Maine, 30,000 eggs of the Shadoe salmon. They were received on the seventeenth of March, 1884, in good condition, and were hatched with only a loss of seven and one half per cent. They were distributed in the lakes as follows:

Bigler	15,000
Donner	5,000
Webber	5,000

The plant of land-locked salmon by the former Commissioners has only been a partial success. Very few of the fish have been taken as yet, although a better showing is looked for. At present writing, the catch has been about the same as last season, no great amount having been captured.

PERCH.

In former years this fish was very plentiful, but has become very scarce in the last few years, owing to several causes, viz.:

First—We believe the greatest cause of disappearance is due to the reclamation of our tule lands by closing the sloughs, whereby ingress and egress is stopped, causing them to deposit their spawn in the rivers, and the spawn is lost by being covered with sediment.

Second—By a continual drain upon the supply by Chinese and other fishermen, who are ever on the alert to find their hiding places.

In our opinion a law should be passed to protect them from seine fishing for at least two years.

For some reason the run of perch has been better this year (1884) than for a number of years past, owing, probably, to the several breaks in the levees between Knight's Landing and Cache Slough, on the Sacramento River, which has allowed the fish egress from the shoal lakes into the tules. Perch are taken in all the lower rivers and streams of the Sacramento and San Joaquin; also in Clear and Tulare Lakes. They do not appear to have decreased in those waters where reclamation has not been so extensive, as in those tule districts above mentioned, but appear to be as plentiful as formerly.

It is not the habit of the perch to ascend very high in any of the streams, but they confine themselves to the more sluggish portions of the waters of the State, lakes and ponds, which seem to be their favorite haunts.

CHUB.

This fish, a great favorite with the Indian and Mongolian races, has been scarce for the past few years, but are now becoming more plentiful, the probable cause of increase being the breaking of the levees in the overflowed districts, which gives the fish a chance to return to the river. The outlook for the year 1884 is good for a fine run, from the fact that in the month of March they were numerous in the river, and, as the run lasts generally two or three months, we may expect a large increase from last year; their habits being similar to the perch, the probabilities are that the same causes lead to the same effects.

PIKE.

With reference to the pike, we repeat the same statement made in regard to perch and chub. The pike is more plentiful at the present time than most of our strictly inland fish. They ascend the rivers higher than most of the other kinds and are thereby protected, as most of the fishermen do not follow them very far up the river. As they are not taken in quantities except by those who fish with fyke nets, they ascend the river as far as Red Bluff. They are said to be a great enemy to the young salmon. They are a good table fish for baking or boiling.

The pike run commences with the channel pike in the month of December, and with the bar or school pike in the month of March. They vary in size from one half pound for bar to twenty-four pounds for channel; there is a marked increase for this year.

These fish are known on the upper waters as whitefish, although they bear no resemblance to the eastern fish of that denomination.

DACE.

The dace, a native of our rivers and lakes, were never very plentiful, and are on the decrease. They are similar in shape, but are different in color from the pike, being of a yellowish brown on the back, and a dingy white on the sides and stomach. The dace are nearly extinct; from what cause, the Commissioners are unable to ascertain at present.

MULLET (OR HARD-HEAD).

The mullet or hard-head is one of the most common of our inland fish, and is used more by the Chinese than by any other class of people—their extreme cheapness being the great desideratum. They are taken in large numbers during the Fall and Winter months.

They inhabit the lakes and sloughs, and also the rivers, but, like some other species of fish mentioned, are getting scarce. In our opinion, they need no protection.

CARP.

The carp has been introduced into the State by the United States Commissioners. They have proven a great success. They do well in any of our lakes and ponds, natural or artificial, and are one of the most prolific of all of the inland-water fish. The condition of the water, whether clear or otherwise, so long as vegetation exists therein, is agreeable to the carp. They are truly vegetarian in regard to diet; living and thriving upon vegetable food. It is the opinion of the Commissioners that the carp are a fish that will come into general favor with the middle class of our citizens, as they can be raised very cheaply by artificial methods. They are well known in China, where they are raised almost entirely by artificial means.

The carp will never be a fish sought after by our Waltons, as they are a fish that seldom take the hook.

Opinions differ in regard to the quality of carp as a food fish; the flesh being of a rather coarse order. They are not so highly flavored as some other kinds of fish.

The carp are already being taken in the Sacramento River, and in some of the lakes bordering on it—not in any great numbers as yet, but enough have been caught to show that they thrive well in our waters. The Commissioners are well satisfied that, in a few years, there will be any quantity of them, as they increase rapidly.

STURGEON.

This is one of our best and cheapest food fishes, and is coming more in favor with all classes of our citizens, and, like most other kinds of food fish, is steadily on the decrease in numbers. This is due almost wholly to the mode of fishing resorted to by the Chinese.

The catch for the year 1883 fell short fully fifty per cent from the result of the catch the previous two or three years. Unless something is done in the way of legislation, the State will, in a few years, be without this kind of fish, one of the best of cheap food fish that inhabit our waters.

In the opinion of the Commissioners, a law should be enacted to protect sturgeon less than twenty-four inches in length. The small ones are not marketable fish, but are dried and sent to China by the Chinese fishermen, who are the only ones that follow that line of the business, they having monopolized the sturgeon trade.

There are two species of this fish that visit our waters; one called the green, and the other the white. They are both good food fish. There is a difference of opinion as to which kind is the best; the majority, however, favor the white.

CATFISH AND BULLHEADS (OR POUT).

These fish were introduced into our waters by the late Commissioners, and have thrived wonderfully. All of the lakes, ponds, and sloughs of the central portion of the State are well stocked with them. It has been stated by fishermen that they would destroy all the native fish. It is our opinion that it was a timely act on the part of the former State Commissioners to plant them just when they did, as our native fish were giving out. They are caught from the mouth of the Sacramento River as far up as Tehama, a distance of about two hundred miles. They are a fish that need no protection. They are so prolific that it is a question if they can ever be exterminated.

Catfish proper are not so plentiful as the bullhead. It is a mistaken idea that all the fish that are called catfish are so in reality. There are two distinct species, however, bearing a near resemblance to each other; the catfish having a peculiar build and a swallow-tail, while the bullhead or pout has a square tail. The pout seems to take to the lakes, while the catfish prefer the river, and are seldom caught in the lakes. They are coming more into favor with our citizens every year. The prejudice that existed at the time of their introduction is fast dying out, and the majority of our people claim that they are a better food fish than the carp. Whether such be the fact is a matter of taste.

The idea that they would destroy our native fish is a fallacy, as, in the last two years, statistics tend to show that such is not the fact. In this statement the disciples of the famed Izaak Walton, we think, will bear us out.

There is also in our lakes and rivers a small native catfish, not very plentiful, and too insignificant to call for any extended notice, the fish being seldom over four inches in length.

WHITEFISH.

This is what might be termed a land-locked shad. The results accruing from the planting of this kind of fish in our waters are not fully known to the Commissioners. They are a fish that do not take the hook, and, as our laws protect the lakes in which they were deposited from all kinds of nets, we have no reliable data as to whether they are a success or not. There are native whitefish that are caught in Lakes Bigler and Donner, which have been taken for those planted by the former Commissioners, but they are different in form from the eastern, being longer and more slim in build, and not so full in the shoulders.

The native, or river whitefish, are taken in great numbers, and are called fresh water herring. They are to be found in all the streams in the State; are small in size, from one half to one pound each. They are in great favor with the Chinese.

There has been no showing of the eastern whitefish so far, although it is five years since they were planted. Up to August thirtieth not one has been taken, so far as the Commissioners have any knowledge.

SHAD.

Since the Commissioners first planted shad in our rivers they have done well, so much so that the whole Pacific Coast can now be said to be well stocked. They have been taken from Monterey Bay on the south, to British Columbia on the north. The shad have large breeding grounds in the waters of the center of the State; their increase has been marvelously great. We have no accurate means of knowing the amount of shad that can be taken in a single day. Enough is known, however, at the present time, to assure us that an unlimited supply can be had in the proper season.

Of all the migratory fish in our waters, the shad is one of the most prolific. Our tule lakes are splendid spawning grounds for them. During the year 1883 the law to protect shad was in force; fishermen who caught them generally returned them to the water, but enough were caught to assure the Commissioners that they had greatly increased in numbers and growth, some being seined that weighed nine and three quarter pounds.

It is the opinion of the Commissioners that California is the only State in the Union where shad can be taken and marketed the year round.

STRIPED BASS.

This most desirable fish is not a native of our waters. A few were planted by the former Commissioners in the Bay of San Francisco at Army Point. In the opinion of the Commissioners they will be a success, as they have been taken in the Bay of San Francisco weighing four pounds, and one taken in the Bay of Monterey in September, 1883, weighed nearly seventeen pounds. It will be some time before striped bass will be very plentiful, as the immense area in which they travel will have to be well stocked before any one place would have any considerable number for the fishermen to work upon. In October, 1883, one was caught in the Sacramento River weighing sixteen pounds. This and other catches are strong evidence that the striped bass will propagate in our waters. The Commissioners find that by reason of thus stocking our bays the whole Pacific Coast is benefited, as in the case with shad. Bass have been taken as far north as British Columbia.

March third, 1884, a striped bass, weighing four pounds, was for sale in a San Francisco market. March eleventh there was one offered for sale that weighed eighteen and one half pounds. It seems to us that most of the eastern fish assimilate themselves very readily to our waters.

SALT WATER FISH.

ROCK COD, OR GROUPER.

This fish abounds in great numbers all along the Pacific Coast. The markets of California are well supplied from the Bays of San Francisco, Monterey, Tomales, and from Punta Arenas and the Farallone Islands; they are caught with hook and line near the rocks and are always in good demand.

Their habits compare with the blackfish of the New England Coast. There are as many as five different varieties; the red is considered the most numerous of all. In the last ten or fifteen years the markets received the most of their supply of this fish from outside the Bay of San Francisco. The decrease in the bay is owing to the same conditions as have caused the decrease of the inland or fresh water fish. They are gradually lessening in number by the continual drain upon them, occasioned by the various devices which our cosmopolitan fishermen use in their capture.

The immense number of small fish of all kinds annually destroyed by the Chinese and other fishermen in the bay, compel the marketmen to look further abroad for their daily supply, as not more than one half of that supply is obtained in the vicinity of San Francisco.

In former years most of the supply was obtained in and around the bays; at present the bays of Monterey, Tomales, Point Reyes, and other points along the coast, north and south, come in for their share of the market supply. As the consumption increases about ten per cent per annum, increasing with the increase of our population, the outlook for years to come is not promising. The Commissioners know of no way to increase the supply of fish of the varieties that are strictly indigenous to our salt waters, as the greater number of species are migratory in their habits—only few kinds remaining the year round in our waters. The best varieties of salt water fish are flounders, soles, turbot, and tomcod, which are taken in good quantities in the inland bays, the greater portion in San Pablo Bay. Sea perch, or porgy, as they are termed in the New England States, are a fine pan fish. Ours, in appearance, are darker in color than the eastern. Herring are considered the most plentiful of all our food fish. They are caught in great numbers in the Winter months, and are always in great demand.

BAY FISH.

San Pedro and San Diego Bays furnish most of the crayfish that are used in the markets of the State. Shoalwater Bay furnishes all of the native oysters, and a large proportion of the clams that are used in the various markets of the State. It is a well known fact that at the present time a large percentage of the food fish that are used throughout the State come from outside bays and rivers; only a small per cent being caught within the Bay of San Francisco.

In the opinion of the Commissioners the catch of all kinds of fish will decrease to a considerable extent in the next five years, if the Chinese are allowed to fish with what is known as bag-nets, for the purpose, as claimed by them, of taking shrimp. The nets they use are so small in size of mesh that they catch and destroy the young of all kinds of food fish by the hundreds of tons annually.

Monterey supplies annually a large number of fish of all kinds to the markets of San Francisco and the State.

EELS, BLACK BASS, AND LOBSTERS.

Eels, placed in our waters by the former Commissioners, have not been a success. It is probable that the place where they were deposited, and where they have made their home, has not yet been discovered; at all events, none have been taken since they were planted. It seems to us that they ought to do well in our inland waters, as they are fond of the bottoms of ponds or streams where mud prevails, as is the case in our lakes and rivers.

Black bass, in our opinion, would do well in all of our large lakes, such as Bigler, Donner, Webber, Clear, and Tulare.

Lobsters may not do well in our latitude. They are not caught in any considerable numbers below forty-one degrees north on the Atlantic Coast. In the opinion of the Commissioners it would be useless to expend any considerable amount to renew the lobster experiment.

In some of the lakes near San Francisco, quite a number of black bass have been taken, and they seem to have done very well.

In this report, the Commissioners who have signed it deemed it proper, in the naming of the various species of fish, to avoid Latin nomenclature, and to call them by the good old Saxon or provincial names by which they have been known to our fishermen and people.

NOTES BY THE COMMISSIONERS.

The fish interest is on the increase all along the line, from the Oregon Coast to the line of Mexico, every bay having its well established fisheries, which send the greater proportion of their catch to San Francisco, where they find a ready market.

Most of the salmon which are exhibited for sale in the months of November, December, and January, are taken up the coast at Point Arenas, Little River, Eel River, Bolinas, and Rogue River. The species consists of what is known as the coast or steel-head. There are a few of the salmon taken at other points that are indigenous to the waters of the Sacramento River.

We would also respectfully state that when the present Commissioners were appointed they were at a loss to know where to commence, as the head of the old Commission, Hon. B. B. Redding, died a few months before, and the only one left was the Hon. S. R. Throckmorton, who was at the time in very poor health; and he also died in a month or so after our appointment, leaving us without any one to confer with who had any knowledge of what was to be done or where to commence. We entered upon our duty as strangers to the business, and it may have cost more to carry on the needed work than it did our predecessors, but when taking into consideration the amount of work done by the present Commission, we confidently believe that the people of this State will approve of our action and endeavors to secure and advance its fish industry.

The present Commissioners have used earnest endeavors to protect the fish interest from the unlawful raids made by unprincipled fishermen during the close season, by employing and placing a patrol on the various bays and watercourses of this State, which action has resulted in great benefit. During the month of August, 1883, the Commission caused the arrest of thirty-six violators of the fish laws, chiefly Greeks and Italians; all were convicted and fined. During the months of September and October, 1883, forty-eight Chinese were arrested for violating the provisions of Section 636 of the Penal Code, by fishing with set-nets, and in nearly all cases convictions were obtained. The Legislature should pass a very stringent law prohibiting the use of set-nets, whether for catching of shrimp or fish; shrimp nets especially are more destructive to the young of all varieties of fish than any other nets used, from the fact that while the fishermen, who are fishing for the market, use nets that will catch nothing but marketable fish, on the other hand, those parties who catch shrimps have their nets made of so small sized mesh that it is impossible for the young of any kind to escape therefrom, thereby catching and destroying immense numbers. The only way to avoid the evil is to stop the catching of shrimp except by the use of proper seines. If the mode adopted by the Chinese is allowed to be continued, in a few years they will have the Bay of San Francisco entirely drained of all kinds of food fish. The number of small fish, shrimp, etc., so taken by the Chinese, and by illicit fishing, amounts to thousands of tons per year. The distribution of fish, in 1883, was not as large as in former years, on account of the fact that the United States Commissioners did not send to the State of California any kinds of fish that they had been accustomed to furnish in former years. Our Commission has sent out from the Shelby hatchery and distributed, between the twenty-first of May, 1883, and the first of January, 1884, over 95,000 trout.

In December, 1883, there were placed 600,000 young salmon in the McCloud River by the United States Fish Commission, at the expense of $600 to the State of California.

On April 13, 1884, the California Commissioners planted ever 200 carp in the lakes of Yolo County, and on April 25 placed a number in China Slough, Sacramento County.

The present Commissioners of the State of California have been unable to place new varieties of fish in the waters of the State, from the fact, mainly, that the United States Commission has not been able to furnish the much desired and needed supply. The United States Commissioner, Hon. Spencer F. Baird, in making annual distribution of fish, up to the year 1883, favored California with its proportion. To him and to his associates the people of this State owe their thanks for the successful stocking of our watercourses and bays with shad, catfish, carp, black bass, striped bass, whitefish, etc.

We most earnestly hope that, in the coming years, we may be favored by the United States Fish Commission with a supply of the different varieties of eastern fish.

VIOLATIONS OF LAWS.

The fish laws have been violated to a great extent on the upper rivers, by unprincipled men, who have established fisheries from Fremont to Redding, on the Sacramento River. The great damage that has been done by these up-river fishermen has been occasioned by the continued drawing of seines upon the gravel bars, not only in the taking of the fish ready to deposit spawn, but also in destroying the ova already deposited upon the gravel bars, these bars being the natural spawning grounds of the salmon. In the opinion of the Commissioners, the State should set apart that section of the river from Jacinto to the McCloud and Pit Rivers as breeding grounds, so that no net or seine could be legally used in that portion of the river. If a law of that character is not passed and enforced, the salmon interest of this State will be of short duration, as the parties using seines on the spawning grounds do more towards annihilating the salmon than all the gill-net fishermen, as the gill nets are nearly of a uniform size of mesh, and only take matured fish, while the seines take all sizes, from one half pound up.

In the opinion of the Commission, it would be wise for the Legislature to enact such laws as will control excessive and prohibit destructive modes of fishing, such as Chinese bag nets, Chinese trout lines, etc., as they are destructive to the young of all kinds of fish.

The Commission would advise that a law be passed to prohibit the use of any weir, pound, bag net, China trout line, set nets, and all other contrivances, in the public waters of this State, with the exception of the fyke nets, and providing that the wings thereof do not extend more than twenty-five feet in the stream from the bank or shore; also, to enact such laws as will prohibit the Indians from taking any kind of fish by any other method than was in use by them prior to 1850.

SHELBY HATCHERY.

The hatching of trout at the Shelby hatchery was started in the month of May, 1883, and during the year there were hatched and distributed over 95,000 trout, and, although this hatchery was started very late in the season for trout hatching, it establishes the fact that the conditions and surroundings are very favorable to the business.

The hatching house was, in 1883, under the charge of Mr. Richardson, a gentleman well versed in the art of propagating fish artificially. Under his management, in the space of two months, over 95,000 were hatched of the species as follows: McCloud River, Lake Bigler, Donner Lake, and Modoc or rainbow trout. After the appointment of the majority of the present Commission they examined into and took charge of the property belonging to the State, which consisted of an old building called a hatchery, situated about one mile from the railroad in Alameda County, near Chabot Lake; some transporting cans, and a few hatching boxes which were not worth moving. As soon as we could conveniently get to work, the Commission found a suitable place for a temporary hatchery, which is situated on what is called Butterfly Creek, between Colfax and Grass Valley, on the Nevada Narrow Gauge Railroad. The Commission received the privilege of building a hatchery house, with the use of a bountiful supply of water, from the owner of the property, Joseph Shelby, Esq.

SACRAMENTO RIVER.

The Sacramento River, which heads in the northern part of the State, runs nearly north and south through four degrees of latitude, and is one of the best salmon streams in the world. At the head the water is clear and icy cold, and the river has a fine gravelly bottom, making fine spawning grounds.

The principal tributaries are the Pit River, which rises in Siskiyou County in Goose Lake, and the McCloud River, which is one of the finest streams in the State of California, and widely noted as a trout stream. Here the United States Commission built their hatchery. The water is very cold, more so than any other stream in the State.

The Feather River is another branch, and in early years was a very good salmon stream, but of late years the salmon have not ascended on account of the impure water.

M'CLOUD RIVER.

The United States hatchery on the McCloud River has been a great benefit to the State of California in years past, on account of the large number of salmon which have been planted and obtained from it in the headwaters of the Sacramento River. The abandonment of the hatchery and of the propagation of fish by the United States Commission, leaves the State of California without any hope of depositing any salmon fry in any of our streams this year (1884). It is to be hoped that our next Legislature will make an appropriation that will enable us to establish a hatchery, in the year 1885, on one of the branches of the Sacramento River. As our interest in the packing of salmon is very great, it occurs to us that the State should make liberal provision in the direction mentioned. The United States hatchery, on the McCloud River, has been virtually given up, and we can expect no further salmon supply in that direction. Unless the Legislature make an ample appropriation for the erection of a State salmon hatchery, the decrease of salmon will annually continue, and in a short time we will neither have the salmon for a food, nor the canneries as an industry, and the fisherman vocation will pass away.

FISH-WAYS, OR LADDERS.

Not many arrests, up to the present time, have been made for the violation of the law by dam owners, in failing to establish ways and ladders.

The dams on the headwaters of the Stanislaus, Tuolumne, San Joaquin, and the upper Sacramento Rivers, are, in our opinion, a great drawback to the salmon interest, as the spawning grounds are, for the most part, above the dams. There being no fishways at the dams, the fish deposit their ova farther down the rivers, where fishermen are using nets, and thereby disturbing the ova and killing every egg that would otherwise mature. The failure to erect proper fish ladders was one of the causes of the decrease of salmon in the year 1884.

APPEAL TO THE LEGISLATURE.

The California Commission call upon the next Legislature to make appropriations for two hatcheries—one for the purpose of hatching trout and keeping the same in proper ponds until they become at least four months old, and a hatchery for the breeding of salmon on the headwaters of the Sacramento River. Without these hatcheries the Commission will be unable to keep up the supply. The demand now exceeds the supply by more than 100,000 matured salmon. The California Commissioners have been dependent upon the United States Commission for all salmon supplies, and we can no longer look for fish in that direction. Because the California salmon do not thrive well in Atlantic waters is the reason why the United States Commissioners have discontinued their work at the McCloud River hatchery.

AMERICAN RIVER.

This branch of the Sacramento River is nearly depleted of all kinds of fish, although most of the small streams which empty into it are well supplied with small brook trout. The same can be said of the Feather and Yuba Rivers. The great cause of depletion is owing to the fact that gold mining has been carried on upon those streams from the first discovery of gold to the present time, causing the water to be heavily charged with debris.

It is the opinion of the Commission that the accumulations of sand, etc., from the mines work great destruction to the ova by covering it with deposit, and also forcing the fish that would naturally breed in these waters to seek other streams where the water is purer.

SAN JOAQUIN RIVER.

This is a very good stream for the Fall run of salmon, the ascent being not very steep, and the current, especially the first seventy-five miles, not being very strong. The different branches form fine spawning grounds, provided the fish could reach their headwaters. The only stream emptying into the San Joaquin not dammed is the Mokelumne. The Tuolumne and Stanislaus are dammed in such a way as to prevent the fish from ascending.

BIG MEADOWS.

These meadows lie in Plumas County. They are grand spawning grounds for trout. The north fork of the Feather River runs through the meadows. The river derives its waters from springs, some of which are extensive, causing large streams to flow into the main river, and furnishes, with a large realm of water, one of the finest spawning grounds in the State—one of the best for feeding, spawning, and fish increase. The water is cold at all seasons of the year; the temperature not higher than sixty degrees Fahrenheit. The waters have been diverted from the original watercourse by what is known as the Watt cut, which, at certain times of the year, leaves insufficient water for fish to ascend over the natural falls in the river, causing great complaint from the property holders along the meadows. They have just cause for complaint.

THE M'CLOUD RIVER.

The McCloud River takes its water supply from the Shasta Buttes. The river runs nearly north and south, with little variation, through six or seven townships, and ranks among the finest of our mountain streams. The water is always cold, varying in depth from three to fifteen feet. It is also a most excellent trout stream, the rainbow and Dolly Varden trout being caught in its waters in great numbers, and weighing from one half pound to eight and ten pounds each.

Salmon also ascend the McCloud in great numbers for the purpose of spawning during the season. At this time of the year it is a known fact that they will readily take the hook, a fact not known to exist in any other river in our State.

The tributary of the Little Sacramento, called Dog Creek, is well stocked with trout that weigh from one half pound to three pounds.

Mosquito Creek is well stocked.

Little Mosquito and Portage Creeks are well stocked with California brook trout, and of average weight with those found in the small streams that empty into the Sacramento, Pit, and McCloud Rivers, making that section of our State one of the best trout fishing localities found in our own State or the United States, as also furnishing the best spawning grounds in the world considering the area.

The different branches of Pit River are as follows:

Hat Creek is well supplied with the rainbow trout, which average from one half pound to four pounds above the falls, and weighing from one half pound to eight pounds below the falls.

Hatchet Creek also abounds with small brook trout.

Bennie Creek, above the falls, is also well filled with large brook trout, pulling the scale at one and one half pounds.

Fall River is also well supplied with the black trout and native whitefish. The latter fish do not resemble the eastern whitefish. In fact all the streams that empty their waters into Pit and McCloud Rivers are all good trout streams and well stocked.

The streams on the eastern divide of the State are not so prolific with trout, although some few are well stocked. The lakes are well supplied. The only streams which appear to have become materially exhausted, are our coast streams in and around San Francisco. This, no doubt, is owing to the large population that indulge in the pastime of angling. There has been a scarcity of food for the trout to feed upon in the upper rivers, but the fish have done better during the last few months. This may have been caused by the continued blasting on the northern railroad in the vicinity of their feeding and spawning grounds.

In our opinion, the McCloud River trout are migratory, and are called on the lower rivers, salmon trout.

CLOSE SEASON.

On the first day of August, 1883, the Commission placed a patrol upon the Sacramento River and adjacent bays, under the direction of W. C. Jones, as Deputy Commissioner. The arrangements for the patrol were completed by the ninth of the month, when the first sortie was made and several parties were arrested for illicit fishing. From the ninth of August, the patrol was kept in the field. In fact, the pirates and violators of the law seemed to forget that there ever was a law passed for the protection of salmon. It was a hard matter to make them believe that the Commissioners were in earnest. Deputy Commissioner Jones at times was compelled to resort to force in order to prevent parties from further violating the laws. In the opinion of the State Commission, Mr. Jones has succeeded, by his energy and intrepidity, in stopping almost all of the lawless and wanton destruction of salmon, especially during the close season of 1883.

During the close season of 1884, viz.: the month of August, there was but little illicit fishing done, except in the last few days of the month, when a few boats ventured out, and those were captured by our deputy, W. C. Jones.

One of the greatest drawbacks to successful work is, the want of a proper conveyance to patrol the rivers, and at all times; sailboats are not always successful in making captures, on account of the fishermen having fast crafts of their own, and, as soon as the Commission's boat is discovered, they escape. This is owing to the fact that the most of their boats are superior sailers. The Commissioners need a good steam launch, with a light draft of water, having speed sufficient to overtake and bring the violators to justice.

REPORT OF DEPUTY FISH COMMISSIONER W. C. JONES.

We herewith submit the report of Deputy Fish Commissioner W. C. Jones:

BIRD'S LANDING, January 1, 1884.

To the honorable Board of Fish Commissioners of the State of California:

GENTLEMEN: In compliance with your request, I hereby submit my report from August 1, 1883, to January 1, 1884.

On the first of August, 1883, I received a deputy commission authorizing me to patrol the Sacramento River, the San Joaquin River, and Suisun Bay.

Up to the ninth of August I succeeded in locating several tanks and salt-houses, where active preparations were being made for the purpose of salting fish during the close season. Up to the ninth, no arrests had been made. On that day, in attempting to arrest two Greeks in Three-mile Slough, one of them, named A. Nicholaus, was killed; the other, John Peterson, was arrested. Nothing more occurred until the fourteenth, when two nets were captured near Chinatown, the owners escaping. On the sixteenth, a raid was planned, using the steam tug Belshaw, owned by Captain Nelson & Co., of the Benicia cannery, and up to the twentieth, we captured thirteen hundred salted salmon and three tanks. In this raid, no owners appeared. On the twenty-first, five men were taken, and on the twenty-second four more, for violating the fish laws; on the twenty-seventh two more, and on the night of the thirtieth sixteen men, making a total for the month of August of twenty-nine individuals. During the month of September nothing of interest occurred.

By directions of your Board a raid was planned to overhaul the Chinese fishermen in San Pablo and San Francisco Bays, and during the ten days following, we captured forty-three Chinamen who were using set-nets. On the twenty-ninth two Greeks were captured near Collinsville, violating the Sunday law. November second, took in four Chinamen with nets set across Cache Slough, and on the eighth four more, for the same offense; making a total number of prisoners up to the eighth of November, inclusive, eighty-two. Of the white fishermen there were thirty-one. Their nationalities are as follows:

Greeks	14
Italians	10
Portuguese	4
Austrians	2
Germans	1

The whole number were convicted, thirteen paying fines of $50 each; the remainder serving out their sentence in jail. Of the Chinamen, fifty-one in number, eighteen were convicted; fifteen were tried at Martinez by jury and released, and five more that were tried at San Rafael were freed by jury, ten convicted, and the remainder were not brought to trial. Nothing more occurred until January 15, 1884, when, by direction of your honorable Board, I descended the Sacramento River to inspect nets. Found two at Courtland, one at

Emmaton, one at Collinsville, below the legal size in length of mesh. The owners were all arrested. The one at Emmaton pleaded guilty and was fined $50 on the twenty-ninth of January.

On the sixteenth of January found two nets below legal size at Courtland. One of the parties pleaded guilty, and on the eighth day of February was fined $50.

COLLINSVILLE, October 20, 1884.

To the honorable the Board of Fish Commissioners:

GENTLEMEN: In compliance with your request, I hereby submit the following report from January 1 to October 23, 1884, inclusive. I have captured the following, viz.:

January 15 to 25—Fourteen Greeks and Italians, charged with stealing a house located on the lower end of Grizzly Island, on or near the north boundary of Suisun Bay. All of the above parties were tried in Fairfield, and found guilty of petty larceny, fined $50 each and costs, aggregating $80 to each prisoner.

February 10—Took in Harry Beyer, John Seevie; February 15—Frist Hartman, Frank Harmainsons, J. D. Crandell, Frank Robies. Discharged.

February 15—Antone Bruers, tried at Benicia, and fined $50.
February 15—Alonzo Pisto, tried at Benicia, and fined $50.
February 25—A. Devoto, tried at Benicia, and fined $50.
February 25—A. Costo, tried at Benicia, and fined $50.
February 25—Santo Lucee, tried at Benicia, and fined $50.
February 25—Christ. Manuel. Sent to jail.
March 15—Peter Bumbus. Sent to jail.
March 15—George Manuel. Sent to jail.
March 12—Peter Dago. Sent to jail.
March 12—John Nacht. Sent to jail.
March 19—Costa Stratto. Sent to jail.
March 19—A. Thedros. Sent to jail.
April 17—Tom Lee. Sent to jail.
April 17—Ah Chung. Sent to jail.
April 17—Ah Gon. Sent to jail.
April 17—Ah Shone. Sent to jail.
April 19—Peter Tom. Fined $50.
April 19—A. Constantine. Fined $50.
May 5—George Brown. Fined $50.
May 5—John Smith. Fined $50.
May 5—Dometry Bobi[illegible]a. Fined $50.
May 5—John Brown. Fined $50.
May 5—Demetro Lawrenco. Fined $50.
May 5—Nicholas Bruces. Fined $50.
May 5—John Mimecha. Fined $50.
May 5—John Andrews. Fined $50.
May 5—George Brown. Fined $50.
May 11—Chas. Kesling. Fined $50.
May 11—Thos. Roberts. Fined $50.
May 11—John Lunes. Fined $50.
May 11—George Journess. Fined $50.
May 19—John Golitto. Jail fifty days.
May 19—Joseph Pogee. Jail fifty days.
June 7—Nicholas Barra. Fined $50.
June 7—Constine Janullo. Fined $50.
June 7—Josey McCorea. Fined $50.
June 7—Alex. Peters. Fined $50.
June 7—Alex. Rozario. Fined $50.
June 9—John Constine. Fined $50.
June 9—Pappello Sofico. Fined $50.
June 9—Christ. Sprego. Fined $50.
June 9—George Allec. Fined $50.
June 9—John Nicholas. Fined $50.
June 16—Nicholas Christ. Fined $50.
June 16—Nicholas Columbus. Fined $50.

August 15—Joseph Largomorisina, Antone Petro, Manuel Gappie, Joseph Penio, Manuel Tarkenia. Held for stealing a cow from Walter Storey of Chipp's Island. Case set for November 15, 1884.

August 29—John Starbo. Fined $50.
August 29—Manuel Dorris. Fined $50.
August 29—Henry Richardson, A. Mastillo, Peter Holker. Jailed.
August 29—John Bell. Fined $50.
August 29—Niel Nelson. Fined $50.
August 29—Chas. Summon, Andrew Faruseth, Martin Busion. Not guilty by jurors.
September 16—Antone Bragell. Fined $50.
September 16—A. Andrews. Fined $50.
September 16—F. Bayo, A. Bosco. Jailed.
September 25—John Spodd. Fined $50.
September 25—M. Calighan. Fined $50.
September 30—Romaro Franeisco, Frank Rittie. Jailed.
October 4—Ah Shun, Gom Lee, Tom Tough, Ah True. Jailed.

Total amouut collected for fines, $2,000.

The foregoing report does not include some forty arrests that I made during the fourteen months that I have been under the employment of the Fish Commissioners. By the partiality of the jurors, and in some cases not having sufficient evidence to convict, many of the violators escaped justice.

The best evidence that I have to offer in the interest of the good accomplished by the river patrol, is the small amount of violations now being committed of the existing fish laws. It is a well known fact that previous to the establishment of an efficient patrol on the rivers and bays, fishermen carried on their unlawful business without restraint.

The following is the number of convicted violators of the law as regards nationality:

Greeks	45
Italians	23
Germans	6
Americans	1
Chinese	18
Total	93

I hereby certify the above report to be correct.

W. C. JONES,
Deputy Fish Commissioner.

HISTORY OF FISH CULTURE.

1850—French Government appointed a Fish Commission.

1850—Norwegian Parliament voted 3,000 thalers for the culture of fish.

1854—Belgian Government organized a fish-breeding establishment on the same principle as France.

1856—Massachusetts appointed a Fish Commission to inquire and report; the result was, that in 1865 the State adopted the present system and granted appropriations.

1857—Russia appointed a Fish Commission; the result of their labor culminating in the establishment in 1862 of a government breeding place in Finland, and by the year 1873 there were ten such in that province.

1860—Russia also subsidized an extensive hatchery at Nicholasky, in the Province of Novgorod.

1865—The State of New Hampshire sent commissioners to Canada for salmon ova. From 1865 to 1870, the State expended some $23,000 for fish culture.

1865—The Austrian Government founded a fish hatchery at Saltzburg, and in 1873, every province in the empire was provided with its own breeding establishments.

1866—The State of Pennsylvania organized a Fish Commission, but no money was appropriated until the year 1873; but between the years 1873 to 1880 inclusive, the amount given through State aid was, for the purpose of public fish culture, nearly $100,000.

1866—The State of Connecticut appointed a Fishery Commission, and appropriated for the purpose of public fish culture, from 1868 to 1880, $44,500.

1866—The Dominion of Canada established a Fishery Commission with a large staff of officers, with ample funds at their command.

1867—The State of Maine appointed a Fish Commission. From 1867 to 1880, appropriations were made to the amount of $38,000.

1868—The State of New York appointed a Commission of Fisheries, and from 1868 to 1879, expended the sum of $169,000.

1870—The State of California appointed a Commission of Fisheries, and from 1870 to 1882, appropriated the sum of about $40,000.

1870—The State of New Jersey appointed a Fishery Commission, and from 1871 to 1880, the appropriations were about $30,000.

1870—Rhode Island appointed a Commission for Fish Culture, and from 1871 to 1880, appropriated $10,000.

1870—Alabama appointed a Fish Commission.

1871—The Congress of the United States of America appointed a Commission of Fish and Fisheries, for all the States of the Union, with a full staff of officers having a knowledge of Fish Culture, and up to 1880, the total sums placed at the disposal of the Commission amounted to about $488,500.

1871—The American Fish Culturist Association organized, and in 1872 applied to Congress to authorize the United States Commission to undertake the duty of restoring fish to the depleted rivers, and a resolution was passed authorizing the United States Commission to fulfill that duty.

1872—At Bucksport, State of Maine, an extensive breeding place was established at the joint expense of certain States and the United States Commission, under the control of the United States Commission.

1873—The State of Ohio appointed a Fish Commission, and from 1873 to 1880 the sums voted for fish culture amounted to nearly $29,500.

1873—The State of Wisconsin appointed a Fish Commission, and from 1873 to 1880 the sum voted for fish culture amounted to about $40,000.

1874—The State of Iowa appointed a Fish Commission, and from 1874 up to 1880 money was appropriated for the artificial culture of fish amounting to $23,500.

1875—The New York Commission succeeded in hatching sturgeon, and were very successful.

1875—The State of Minnesota appointed a Fish Commission, and from 1875 to 1880, sums were appropriated amounting to $23,000.

1876—The State of Kentucky appointed a Commission of Fisheries, and from 1876 to 1880 the various sums appropriated for fish culture were, in total, $11,000.

1877—The State of Kansas appointed a Fish Commission, and from 1877 to 1880 appropriated for fish culture the sum of $2,500.

1877—Germany and the United States were successful in the artificial hatching of herring.

1877—United States successfully introduced three species of carp from Germany.

1877—United States Congress established a Government carp pond by special appropriation, from which pond several hundred thousand carp have been distributed to all parts of the United States.

1877—The State of Colorado established a Fishery Commission, and from 1877 to 1880 appropriated for fish culture the sum of $2,000.

1877—The State of Nevada appointed a Fish Commission, and from 1877 to 1880 the sum of $2,500 was appropriated.

1877—West Virginia appointed a Commission of Fisheries, and from 1877 to 1880 there was appropriated for fish culture about $4,000.

1877—There was one salmon caught in the Delaware River, and in 1878 there were several hundred taken.

1876—Salmon were planted in the Connecticut River, and in 1878 the fishermen caught more than six hundred.

1878—Sole were introduced by the United States Commission into the United States.

1878—Codfish were successfully hatched on the coast of Massachusetts by the United States Commission of Fisheries.

1879—Haddock were successfully hatched, in large numbers, by the United States Commission of Fisheries on the coast of Massachusetts.

1880—The United States Government built and equipped a large steam vessel for the transportation of fish.

1880—Spanish mackerel and other species of European fish were introduced by the United States Commission.

1880—Countries to which prizes were awarded at the Berlin International Exhibition, were as follows:

United States: Six gold medals, one silver, one bronze, and two honorable mentions.

Germany: Three gold, one silver, three bronze, and eleven honorable mentions.

Russia: One gold, one silver, one bronze, and one honorable mention.

Norway: One silver medal.

Sweden: One silver medal.

Austria: One bronze medal.

Switzerland: One bronze medal.

The people of the United States may well feel proud of the awards above mentioned. It shows that the people of the United States are the most progressive, energetic, and in fact the foremost in the art of fish culture. To-day, in such respect, the United States takes the lead of all other countries in the civilized world, and it is to be sincerely hoped that she will continue to maintain the supremacy.

REPORT OF TREASURER.

To the Commission of Fisheries of the State of California:

Appended find your Treasurer's statement and reports of receipts and disbursements from March 3, 1883—at which time the present Board was organized—up to December 3, 1884.

As to receipts, to the extent they have come from State appropriations, in this report will be found, in consecutive order, the number, date, and amount of each of the Controller's warrants.

The accounts covered by these warrants were presented to and approved by the State Board of Examiners, and are now on file in the proper State department.

All other disbursement accounts were paid by bank checks, and, on settlement of the bank account, these paid checks have been returned, and are now on file as vouchers.

Having given to the fish industry of California, personally and as one of the Commissioners, much consideration, I deem it not inappropriate for me, in this report, to present a few suggestions.

In order to protect and increase the fish industry, I suggest that an appropriation of $3,000 be solicited from the ensuing Legislature, to enable the Fish Commissioners to purchase a swift steam launch, by means of which the Commission and its patrol may successfully pursue, overtake, arrest, and bring to punishment all violators of the fish laws, and to drive the Chinese and other offenders from our bays and rivers.

I further suggest that the State appropriate $10,000 to be expended by the Board of Fish Commissioners in the establishment and construction of a State salmon hatchery—the hatchery to be erected at an available site on one of the upper tributaries of the Sacramento River. The hatchery should have a hatching capacity of 6,000,000, with ample storage reservoirs for the safety of the young fry, until, by size, they can protect themselves from the devouring large fish. It is reported by the United States Fish Commissioner that from September, 1873, to November, 1882, 18,337,000 young salmon were released from the United States hatchery into the McCloud River, a tributary of the Sacramento. Whilst I have much reason to question the statement as to numbers, I fully appreciate the obligation of our citizens to the Government of the United States and her Commissioners for a very generous and valuable supply. The General Government having practically, if not positively abandoned all work of supply in the direction mentioned, the State must do it or lose the salmon.

In my judgment this branch of *fish culture* demands immediate and active attention of the Commission and the Legislature.

I further suggest that a "boat license law" be enacted, requiring all persons and parties known as market or cannery fishermen, and those engaged in catching fish to dry, salt, or transport, to pay a license tax upon each boat used by them in their vocation. Such law will have the approval of the law abiding fishermen.

I further suggest that the State appropriate, for the thirty-seventh fiscal year, $7,000, and for the thirty-eighth fiscal year, $6,000, and that a special appropriation of about $1,000 be made to cover the deficiencies of the thirty-fifth and thirty-sixth fiscal years.

Submitted.

A. B. DIBBLE,
Commissioner and Treasurer.

MISCELLANEOUS RECEIPTS AND DISBURSEMENTS.

Date.		Amount.
1883.	*Receipts.*	
March 3	Cash received from former Commission, deposited with Anglo-Californian Bank	$6,504 11
March 3	Cash from estate of Traylor	21 28
June 26	Cash returned by J. D. Redding	97 40
November 9	Cash returned by J. D. Redding	55 00
1884.		
February 19	Cash from Sacramento River Packing Company	200 00
		$6,877 79
1883.	*Disbursements.*	
March 5	Paid J. G. Woodbury, labor account	$230 25
March 10	Paid Francis & Valentine, printing annual report and express'ge	54 25
March 12	Paid Wells, Fargo & Co., freight on eggs from East	60 00
March 15	Paid Livingstone Stone, 4,000,000 salmon eggs	2,000 00
March 24	Paid J. G. Woodbury, salary and expenses	44 00
April 2	Paid R. H. Buckingham, expense account	10 00
April 10	Paid R. E. Wilson, counsel fee	100 00
April 18	Paid John Sissengood, balance labor account	15 00
April 25	Paid Wells, Fargo & Co., expressage	4 45
May 5	Paid J. D. Redding, expense account	40 00
June 9	Paid R. H. Buckingham, expense account	130 00
June 9	Paid A. B. Dibble, expense account	50 00
June 9	Paid J. D. Redding, expense account	125 00
July 4	Paid J. A. Richardson, salary and expense account	100 00
July 12	Paid Weisbien Bros., fish eggs	24 00
July 13	Paid J. G. Woodbury, expense account	18 00
August 14	Paid R. H. Buckingham, enforcing Section 634 Civil Code	500 00
July 19	Paid Peter Johnston, merchandise for hatchery	173 23
August 14	Paid J. D. Redding, expense account	40 00
August 8	Paid Mohawk Lumber Company, lumber	49 33
August 17	Paid J. A. Richardson, salary and expenses	100 00
August 18	Paid California Wire Works, wire	14 75
August 18	Paid J. D. Redding, expense account	210 00
August 20	Paid A. C. Lowell & Co., merchandise	20 00
	Amount carried forward	$4,112 26

MISCELLANEOUS RECEIPTS AND DISBURSEMENTS—Continued.

Date.		Amount.
	Amount brought forward	$4,112 26
August 31	Paid R. H. Buckingham, expense account	189 30
September 5	Paid Samuel Granger (for J. A. Richardson), labor account	50 00
September 10	Paid James Dobbins, for services and labor on river	539 50
September 10	Paid W. C. Jones, for services and labor on river	530 00
September 12	Paid J. A. Richardson, for services and labor on river	300 00
September 22	Paid A. B. Dibble, cash advanced and expenses	384 50
September 28	Paid H. S. Crocker & Co., printing	6 00
September 29	Paid R. H. Buckingham, expense account and Chinese prosecution, etc.	250 00
October 10	Paid R. H. Buckingham, expense account and Chinese prosecution, etc.	100 00
October 15	To Huntington, Hopkins & Co., merchandise	9 93
November 20	To H. Woodson, trout eggs	20 25
November 20	To A. B. Dibble, expense account	12 37
December 24	To A. R. Hamlin, labor account	90 00
December 31	To Wells, Fargo & Co., expressage	3 40
December 31	To discount on State warrant	18 76
1884.		
February 19	Paid C. H. Rogers, boat and service (Sacramento River Packing Company)	75 00
---------- ----	Paid June, October, and December, 1884, discount on State warrants	53 27
------ --------	Paid, July, 1884, Wells, Fargo & Co., expressage	1 55
------ --------	Paid Mohawk Lumber Company, on bill omitted by error in claim No. 5	12 75
		$6,758 84
	Balance unexpended	118 95
		$6,877 79

SUMMARY OF EXPENDITURES OF APPROPRIATION FOR THIRTY-FIFTH FISCAL YEAR.

	To appropriation	------------	$5,000 00
1883—October 29	1. By warrant No. 1,952	$1,250 28	
December 21	2. By warrant No. 2,971	1,568 35	
1884—February	3. By warrant No. 3,969	552 00	
March 4	4. By warrant No. 4,334	180 00	
May 21	5. By warrant No. 6,835	763 70	
June 28	6. By warrant No. 7,136	544 20	
August 16	7. By warrant No. 536	* 141 47	
			$5,000 00

* This is the amount paid of the claim for $896 45—see below.

CONDITION OF APPROPRIATION FOR THIRTY-FIFTH FISCAL YEAR.

To claim No. 1—Expenses	$1,250 28
To claim No. 2—Expenses	1,568 35
To claim No. 3—Expenses	552 00
To claim No. 4—Expenses	180 00
To claim No. 5—Expenses	763 70
To claim No. 6—Expenses	544 20
To claim No. 7—Expenses	896 45
	$5,754 98
By amount drawn as above	5,000 00
Deficiency in appropriation to pay claim No. 7	$754 98

STATEMENT IN DETAIL OF EXPENSES OF APPROPRIATION FOR THIRTY-FIFTH FISCAL YEAR, BEGINNING JULY 1, 1883, AND ENDING JUNE 30, 1884.

Claim No. 1, *August* 6, 1883, *to October* 13, 1883, *inclusive.*

1.	To W. C. Jones, patrol and expense account	$664 65	
2.	To R. H. Buckingham, expense account	163 38	
3.	To Charles Donicke, boat and services	50 00	
4.	To Carquinez Packing Company, tug service	80 00	
5.	To S. Marsich, merchandise	25 80	
6.	To Peter Terrillo, sloop and expenses	65 95	
7.	To John J. Murphy, services	32 00	
8.	To J. Grimley, labor on river	15 00	
9.	To F. M. Angelotti, retaining fee	40 00	
10.	To John Ferrin, services, cash, etc.	103 50	
11.	To D. Odds and Lot Smith, keepers' fees	10 00	
			$1,250 28

Claim No. 2, *September* 22, 1883, *to November* 20, 1883, *inclusive.*

1.	To A. B. Dibble, expense account	$187 40	
2.	To R. H. Buckingham, expense account	133 60	
3.	To W. C. Jones, labor and expenses	415 35	
4.	To Livingstone Stone, salmon eggs	600 00	
5.	To W. J. Hugh, board, etc.	13 00	
6.	To Frederick Buckingham, services	76 00	
7.	To John Cropper, services	69 50	
8.	To sloop Bessie, Captain Ferrella	73 50	
			1,568 35

Claim No. 3, *November* 11, 1883, *to January* 31, 1884, *inclusive.*

1.	To J. N. Gill (W. C. Jones), merchandise	$12 85	
2.	To F. M. Angelotti, legal services	20 00	
3.	To John Cropper, services	25 00	
4.	To Jacob Cantrell, services	30 00	
5.	To Charles Dagnol, services and boat	45 00	
6.	To Wm. T. Wallace, Jr., legal services	80 00	
7.	To R. H. Buckingham, expense account	102 15	
8.	To D. H. Burton, labor, etc.	110 00	
9.	To W. C. Jones, labor and expenses	127 00	

Claim No. 4, *February* —, 1884.

	To A. B. Dibble, expense account	$180 00	
			180 00

Claim No. 5, *January* 8, 1884, *to April* 17, 1884, *inclusive.*

1.	To J. D. Johnson, labor	$18 00	
2.	To W. C. Jones, services and expenses	113 50	
3.	To Eureka Lumber Company, lumber	40 71	
4.	To Peter Johnson, hardware	109 49	
5.	To J. Shebley, services, etc.	48 50	
6.	To J. C. Frazier, one month's salary	100 00	
7.	To J. Shebley, fish, expenses, and labor	95 55	
8.	To R. H. Buckingham, expenses	118 40	
9.	To J. C. Frazier, salary, expenses, etc.	116 90	
10.	To Mohawk Lumber Company, lumber	2 65	
			763 70

Claim No. 6, *February* 10 *to May* 9, 1884, *inclusive.*

1.	To R. H. Buckingham, expense account	$83 05	
2.	To A. B. Dibble, expense account	333 85	
3.	To J. C. Frazier, salary, expenses, etc.	127 30	
			544 20

Claim No. 7, July 23 to December 11, 1884, inclusive.

1. To Lenni Fish Company, fish	$125 00	
2. To J. A. Richardson, salary and expenses	328 50	
3. To H. Woodson, 25,000 trout	200 00	
4. To W. C. Jones, sloop and services	90 00	
5. To J. C. Frazier, salary, expenses, etc.	107 95	
6. To John Healey, boat and services	45 00	
		896 45
Apportioned all that was received from the warrant		141 47
Total expenditures		$5,000 00

NOTE.—Claim No. 7 allowed, $896 45; balance in appropriation, $141 47; deficiency, $754 98.

EXPENDITURES FOR THIRTY-SIXTH FISCAL YEAR, ENDING JUNE 30, 1885.

To appropriation			$5,000 00
By expenditures, Claim No. 1, Warrant 537, July 6 to July 13, 1884, inclusive.			
1. To J. C. Frazier, salary and expenses	$178 30		
2. To W. C. Jones, salary and expenses	40 00		
3. To W. C. Jones, sloop and services	200 00		
4. To J. C. Frazier, expenses, Lake Tahoe	16 50		
		$434 80	
Claim No. 2, Warrant 1,839, from July 1, 1884, to August 11, 1884, inclusive.			
1. To J. Shebley, cash and labor	$168 10		
2. To Bosqui, engraving and printing	25 00		
3. To W. C. Jones, salary and expenses	600 00		
4. To R. H. Buckingham, expense account	154 65		
		947 75	
Claim No. 3, Warrant 3,088, December 2, 1884.			
1. To J. C. Frazier, services and expenses	$247 95		
2. To W. C. Jones, services and expenses	160 00		
3. To R. H. Buckingham, expense account	98 35		
		506 30	
4. To A. B. Dibble, expense account		365 04	
			2,253 89
Balance unexpended			$2,746 11

RECAPITULATION.

Receipts.

Miscellaneous		$6,877 79
Appropriation thirty-fifth fiscal year		5,000 00
Appropriation thirty-sixth fiscal year		2,253 89
		$14,131 68

Disbursements.

Miscellaneous	$6,758 84	
Thirty-fifth fiscal year	5,000 00	
Thirty-sixth fiscal year	2,253 89	
		14,012 73
Balance unexpended		$118 95

DISTRIBUTION OF FISH, 1883.

5,000 trout in Butterfly Creek, above reservoir, Nevada County.
33,000 trout in the upper waters American River.
15,000 trout in Webber Lake.
5,000 trout in Butterfly Creek, below reservoir.
8,000 trout in San Bernardino County.
300 carp in Yolo County.
29,000 trout in Donner, Webber, and Independence Lakes.

25,000 trout in Sonoma Creek.
30,000 trout in Modoc County streams.
5,000 land-locked salmon in Independence Lake.
10,000 land-locked salmon in Donner Lake.
10,000 land-locked salmon in Bigler Lake.
2,000 trout at Folsom.
500 catfish at Fresno.
10,000 trout in Bear River, Placer County.
20,000 trout in South Yuba River.
10,000 trout in American River.
2,000 trout in stream at Nevada City.
5,000 trout at Steep Hollow.
10,000 trout in streams of Santa Clara County.
10,000 trout in streams of Santa Cruz County.
70,000 trout on hand for distribution at Shebley.
600,000 salmon in Sacramento River.
100,000 salmon-trout (eastern), now being hatched at Shebley.
300 land-locked salmon in Butterfly Creek and above reservoir.

LIST OF FISH COMMISSIONERS.

UNITED STATES.

Prof. Spencer F. Baird ---------- Washington, D. C.

ALABAMA.

Col. D. R. Hundley ---------- Mooresville
Hon. Charles S. G. Doster ---------- Prattville

ARIZONA.

Hon. J. J. Gosper ---------- Prescott
Hon. Richard Rule ---------- Tombstone
J. H. Taggart ---------- Yuma

ARKANSAS.

J. E. Reardon ---------- Little Rock
J. H. Hornibrook ---------- Little Rock
H. H. Rottaken ---------- Little Rock

CALIFORNIA.

J. D. Redding ---------- San Francisco
A. B. Dibble, Secretary and Treasurer ---------- Grass Valley
R. H. Buckingham, President ---------- Sacramento

COLORADO.

Wilson E. Sisty ---------- Idaho Springs

CONNECTICUT.

Dr. W. M. Hudson ---------- Hartford
Robert G. Pike ---------- Middletown
James A. Bill ---------- Lyme

DELAWARE.

Enoch Moore, Jr. ---------- Wilmington

GEORGIA.

Hon. J. T. Henderson	Atlanta
Dr. H. H. Cary, Superintendent of Fisheries	

ILLINOIS.

N. K. Fairbank	Chicago
S. P. Bartlett	Quincy
S. P. McDole	Aurora

INDIANA.

Calvin Fletcher	Spencer, Owen County

IOWA.

B. F. Shaw	Anamosa
A. A. Mosher	Spirit Lake

KANSAS.

W. S. Gale	Venango

KENTUCKY.

William Griffith, President	Louisville
John B. Walker	Madisonville
P. H. Darby	Princetown
Hon. C. J. Walton	Munfordville
Hon. John A. Steele	Versailles
W. C. Price	Danville
Dr. William Van Antwerp	Mount Sterling
Hon. M. J. Chambers	Independence, Kenton County
A. H. Goble	Collettsburg
J. H. Malory	Bowling Green

MAINE.

E. M. Stilwell	Bangor
Henry O. Stanley	Dixfield

MARYLAND.

G. W. Delewader	Oakland
Thomas Hughlett	Easton

MASSACHUSETTS.

E. A. Brockett	Winchester
E. H. Lathrop	Springfield
F. W. Putnam	Cambridge

MICHIGAN.

Dr. J. C. Parker, President	Grand Rapids
A. J. Kellogg	Detroit
J. H. Bissell	Detroit

MINNESOTA.

First District—Daniel Cameron	La Crescent
Second District—William W. Sweeney, M.D.	Red Wing
Third District—R. Ormsby Sweeney, President	St. Paul

MISSOURI.

John Reid	Lexington
J. G. W. Steedman, Chairman	2803 Pine Street, St. Louis
J. S. Logan	St. Joseph

NEBRASKA.

R. R. Livingston	Plattsmouth
W. L. May	Fremont
B. E. B. Kennedy	Omaha

NEVADA.

Hon. Hub. G. Parker	Carson City

NEW HAMPSHIRE.

George W. Riddle	Manchester
Luther Hayes	South Milton
Eliott B. Hage	Plymouth

NEW JERSEY.

Theo. Morford, President	Newton
Richard Jenkins	Camden
William Wright	Newark

NEW YORK.

Hon. R. Barnwell Roosevelt, President	76 Chambers Street, New York
Gen. Richard U. Sherman, Secretary	New Hartford
Edward M. Smith	Rochester
Eugene G. Blackford	No. 80 Fulton Market, New York

NORTH CAROLINA.

S. G. Worth	Raleigh

OHIO.

Col. L. A. Harris, President	Cincinnati
Charles W. Bond, Treasurer	Toledo
Halsey C. Post, Secretary	Sandusky

PENNSYLVANIA.

Hon. B. L. Hewitt	Hollidaysburg
James Duffy	Marietta
John Hummel	Silingsgrove
G. M. Miller	Wilkesbarre
John Gay	Greensburg
Arthur Maginnis	Swiftwater

RHODE ISLAND.

John H. Barden	Rockland
Henry I. Root	Providence
Col. Amos Sherman	Woodsocket

SOUTH CAROLINA.

Hon. A. P. Butler	Columbia
C. J. Huske	Columbia

TENNESSEE.

W. W. McDowell	Memphis
H. H. Sneed	Chattanooga
Edward D. Hicks	Nashville

TEXAS.

John H. Lubock	Austin

VERMONT.

Hiram A. Cutting	Lunenburgh
Herbert Brainard	St. Albans

VIRGINIA.

Colonel Marshall McDonald	Berryville

WEST VIRGINIA.

Henry B. Miller, President	Wheeling
C. S. White, Secretary	Romney
N. M. Lowry	Hinton

WISCONSIN.

The Governor, Wm. E. Smith, ex officio	Madison
Philo Dunning, President	Madison
C. L. Valentine, Secretary and Treasurer	Janesville
J. V. Jones	Oshkosh
John F. Antisdel	Milwaukee
Mark Douglas	Melrose, Jackson County
C. Hutchinson	Beetown, Grant County

WYOMING TERRITORY.

Dr. M. C. Barkwell, President	Cheyenne
Otto Gramm, Secretary	Laramie
N. L. Andrews	Jackson County
E. W. Bennett	Carbon County
P. J. Downs	Unita County
T. W. Quin	Sweetwater County

WASHINGTON TERRITORY.

Albert B. Stream	North Cove

DOMINION OF CANADA.

W. H. Whitcher, Commissioner	Ottawa, Ontario

PROVINCE OF NEW BRUNSWICK.

W. F. Venning, Inspector of Fisheries	St. John

PROVINCE OF NOVA SCOTIA.

W. H. Rogers, Inspector	Amherst

PROVINCE OF PRINCE EDWARDS ISLAND.

J. H. Duvar, Inspector	Alberton

PROVINCE OF BRITISH COLUMBIA.

A. C. Anderson	Victoria

SCOTCH FISHERIES IMPROVEMENT ASSOCIATION.

His Grace the Duke of Sutherland, President.
The Right Hon. the Earl of Breadalbane, Vice-President.
The Right Hon. the Earl of Dalhousie.
The Right Hon. Lord Polworth.
David Milne Home, Esq., of Milne Gordon.

COUNCIL.

The Right Hon. the Earl of Leven and Melville.
The Right Hon. Lord Abinger.
Major-General A. McDonald, of Dalhousie.

E. A. Stewart Gray, Esq., of Gray & Kinfauns, Chairman of Tay District Board.
J. Maxtone Graham, Esq., of Cultoquhey.
Archibald Young, Esq., Inspector of Salmon Fisheries of Scotland, Edinburgh.
David Lang, Esq., W. S., President of the Edinburgh Angling Club.
J. W. Young, Esq., W. S., Edinburgh.
J. F. Cathcart, Esq., Edinburgh.
John Clark, Esq., Secretary of the Echaig Angling Club, Glasgow.
J. A. Harvie Brown, Esq., of Quarter and Shingarton.
William Menzies, Esq., Secretary of the Edinburgh Angling Club.
George H. Handasyde, Esq., Edinburgh.
J. Barker Duncan, W. S., Hon. Secretary, No. 6, Hill Street, Edinburgh.

SALMON CANNERIES OBTAINING FISH FROM THE SACRAMENTO.

Banner Packing Company	San Francisco
Benicia Packing Company	Benicia
Booth & Co. Packing Company	Collinsville
Booth & Co. Packing Company	Chipp's Island
S. Booth & Co. Packing Company	Black Diamond
W. B. Bradford Packing Company	Collinsville
Carquinez Packing Company	Benicia
Chas. Taylor & Co.	Rio Vista
Cutting Packing Company	Martinez
Courtland Packing Company	Courtland
Capital Packing Company	Sacramento
Columbus Packing Company (F. M. & Co.)	San Francisco
Columbus Packing Company	San Francisco
Jones & Anderson	Sacramento
King, Morse & Co.	Black Diamond
Red Cross Packing Company	San Francisco
Robt. Carter & Co.	Rio Vista
Suisun Packing Company	Suisun Bay
Sacramento River	Chipp's Island
Occident and Orient	Smith's River
Pacific Coast.	Eel River

The increase since 1879 in the number of outfits for the taking of salmon, and especially in 1883 and 1884, have nearly trebled, the nets and boats increasing from two hundred and twenty to over fifteen hundred. The nets now have an average length of over three hundred fathoms or eighteen hundred feet each.

The cost of running the different canneries varies considerably, owing to various causes, mainly:

First—Capacity.

Second—Structure.

The cost of running the canneries will average about $50,000 each per annum.

The cost of each net is about on an average of $200. The nets have to be renewed annually, or sooner, owing to wear and tear and accidents.

The cost of fishermen's boats average $200 each on the lower end of the river, while the boats on the upper river, being principally skiffs, cost about $40 each.

CANNERIES ON THE COLUMBIA.

Showing the immense production of food from salmon.

Aberdeen Packing Company, Quilwact, Oregon	27,500 cases
Adair Packing Company, Astoria, Oregon	11,000 cases
Astoria Packing Company, Astoria, Oregon	20,000 cases
Anglo-American Packing Company, Astoria, Oregon	12,500 cases
Bactolet & Co. Packing Company, Astoria, Oregon	24,000 cases
D. Morgan J. R. Packing Company, Astoria, Oregon	
A. Booth & Co. Packing Company, Astoria, Oregon	
Columbia Canning Company, Washington Territory	16,200 cases
Columbia River Packing Company, Astoria, Oregon	
John A. Devlin & Co., Astoria, Oregon	26,000 cases
Eureka Packing Company, Eureka, Washington Territory	20,000 cases
Samuel Elmore Packing Company, Astoria, Oregon	10,000 cases
Fishermen's Packing Company, Astoria, Oregon	17,500 cases
Hapgood & Co. Packing Company, Waterford, Oregon	10,000 cases
Hartshorne & Co. Packing Company, Astoria, Oregon	16,000 cases
R. D. Hume Packing Company, Astoria, Oregon	14,000 cases
William Hume Packing Company, Astoria, Oregon	16,000 cases
William Hume Packing Company, Eagle Cliff, Washington Territory	

I. X. L. Packing Company, Astoria, Oregon	8,500 cases
Knappton Packing Company, Knappton, Washington Territory	8,500 cases
George T. Meyers & Co., Rainet, Oregon	15,000 cases
J. G. Megler Packing Company, Brookfield, Washington Territory	20,000 cases
Ocean Packing Company, Bay View, Washington Territory	13,000 cases
Oregon Packing Company, Clifton, Oregon	
Occident Packing Company, Astoria, Oregon	15,000 cases
Union Pacific Packing Company, Astoria, Oregon	15,500 cases
Point Adams Packing Company, Astoria, Oregon	
Pillar Rock Packing Company, Pillar Rock, Washington Territory	12,500 cases
Scandinavian Packing Company, Astoria, Oregon	18,500 cases
Sea Side Packing Company, Astoria, Oregon	10,800 cases
White Star Packing Company, Astoria, Oregon	16,500 cases
Union Packing Company, Astoria, Oregon	20,800 cases
Wests Co. Packing Company, Hungry Harbor, Oregon	16,000 cases
West Coast Packing Company, Astoria, Oregon	16,000 cases
Jas. Williams & Co. Packing Company, Astoria, Oregon	8,900 cases
Thomas & Knowles Packing Company, Astoria, Oregon	18,000 cases
F. M. Warren & Co., Cascades, Oregon	10,000 cases
Warren & Co., Cascades, Oregon	
Washington Company, Astoria, Oregon	14,000 cases
Bath Canning Company, Gardner, Oregon	
Gardner Packing Company, Gardner, Oregon	
Jas. Williams, Tacoma, Washington Territory	
Puget Sound Cannery, Milton, Washington Territory	
R. D. Hume, Rogue River, Oregon	
Tillamook Packing Company, Hobsonville, Oregon	
Washington Packing Company, Grey's Harbor, Oregon	

BRITISH COLUMBIA AND ALASKA CANNERIES.

Balmoral Canning Company, Skeena River
British America Canning Company, Canoe Pass
British Columbia Canning Company, New Westminster
British-American Canning Company, Skeena River
British Union Packing Company, Ladner's Landing, British Columbia
Cape Fox Packing Company, Cape Fox, Alaska
Chilkat Packing Company, Chilkat, Alaska
Cutting Packing Company, Cook's Inlet
Delta Packing Company, Ladner's Landing, British Columbia
Douglas Packing Company, Nass, British Columbia
E. A. Wadhams Packing Company, Excelsior Landing, British Columbia
English & Company Packing Company, New Westminster, British Columbia
Ewen Packing Company, New Westminster, British Columbia
Findley & Company Packing Company, Deas Island, British Columbia
Inverness Packing Company, Inverness, British Columbia
Joseph Spratt Floating Cannery, ———, British Columbia
Karluck Floating Cannery, Kodiac Island, Alaska
Laidlaw & Company, Lapperton, British Columbia
Mettakath, Mettakath, British Columbia
Nass River Fishing Company, Nass River, British Columbia
Nimpkish Cannery, Alert Bay, British Columbia
North Pacific Trading Company, Kalawack, Alaska
Richmond Canning Company, North Arm, British Columbia
River Inlet Canning Company, Queen Charlotte Sound, British Columbia
Robert Cunningham Canning Company, Coquitlan, British Columbia
Wachusett Canning Company, Alaska
Wellington Canning Company, Wellington Landing, British Columbia
Windsor Canning Company, Aberdeen, British Columbia
Quashela Packing Company, Skeena River
Wanmuck Packing Company, River Inlet

Respectfully submitted.

R. H. BUCKINGHAM,
A. B. DIBBLE,
Fish Commissioners.

3 9

BIENNIAL REPORT

OF THE

COMMISSIONERS OF FISHERIES

OF THE

STATE OF CALIFORNIA,

FOR

1885-1886.

COMMISSIONERS.

R. H. BUCKINGHAM, Sacramento, President.
A. B. DIBBLE, Grass Valley, Secretary.
T. J. SHERWOOD, Marysville.

Library Copy
FRANCISCO, CALIF.

SACRAMENTO, CAL.
STATE OFFICE..........JAMES J. AYERS, SUPT. STATE PRINTING.
1886.

REPORT.

To his Excellency GEORGE STONEMAN, *Governor of California:*

The Commissioners of Fisheries for the State of California, appointed under an Act of the Legislature entitled "An Act to provide for the restoration and preservation of fish in the waters of the State," approved April 2, 1870, respectfully submit their ninth biennial report:

The Commissioners refer with much pleasure to the fact, that since their last biennial report, public interest has greatly increased, in regard to the fish industry of this commonwealth, and favorable to the adoption of measures and means for increased propagation, and more ample protection of the fish of the State. In nearly all of the States and Territories, their Legislatures have recognized the great importance of fish culture and protection, by the enactment of protective laws and liberal appropriations. Opposition to "Fish Commissions" has been disarmed, and increased energy on part of Commission and State has been demanded. Our citizens call for a larger supply of choice cheap and healthy fish food. This universal demand should be answered in fostering laws and generous appropriations.

Your Commissioners are pleased to report, that during the last two years—notwithstanding the heavy drain made upon our waters, by hordes of alien fishermen, using criminal methods, and for foreign deportation—the catch of most of the food fishes has been measurably satisfactory. During these, and a part of the preceding two years, it has been the aim of this Commission, to the extent of the power and means allowed it, to stay all vandal waste, and to drive from our waters all classes of fishermen, except those who respect our laws, the present interests of our citizens, and the future prosperity of our fast growing commonwealth.

The "patrol work" inaugurated by the present Commission (expensive as it has been and must be), was forced upon it by reason of the decrease of salmon and other species of fish, and as a means of protection and restoration.

SALMON.

It is a matter of serious regret that our choicest and most valued fish, the Quinnat salmon, is annually decreasing, and the supply for exportation and home consumption is diminishing. Unless salmon that now home in our waters are protected and fostered as a nucleus for increase, our rivers will become as barren of this most desired fish as is the Connecticut and other eastern rivers. The causes of impoverishment are various, and are well known. In our last biennial report we alluded to them at length, and expressed the opinion that the decrease would annually continue until at least some of the causes were removed, and until the efforts of the Commission, by its patrol work for protection and hatchery work for restoration, could be realized; and that restoration by means of replanting could not be appreciable sooner than four or more years after the release of young salmon into our watercourses. The present Commission was informed that four millions of young salmon were released in the year 1881, from the United States salmon station on the McCloud, into the headwaters of the Sacramento River. If such was the fact, although five years have elapsed, that plant has not yet made a showing.

The salmon Spring run of the year 1885 was probably fifty per cent less than the early run of 1884. The Fall run—owing in part to the low stage of water—showed a falling off of about thirty per cent over that of the preceding year. During the present year the decrease has been marked and steady. The pack of 1885 diminished fully fifty per cent from that of the year 1884, and has decreased during the present year.

The Spring season of 1886 opened favorable for a good run. The river was high in December, and held well up into January. Notwithstanding promising conditions, but few fish were taken in December and January. February presented a slightly increased run over that of the same month in the preceding year. March and April presented the same result. The run up to the latter part of April seemed to be confined to the Sacramento River below Rio Vista. In latter part of April catches were reported from mouth to Sacramento City. In May the takes were notably small. June (always regarded as a favorable month for a good run), opened with a small increase, which lasted but a few days. During the last of this month few fish were taken, and the fishermen, in disappointment, housed their nets. The run below Rio Vista was quite good during the month of August, and during the close season, "between the thirtieth day of August and the first day of October," the run above Sacramento City, in the upper waters of the river and its tributaries, was the best of the year.

Our Commission will this year release from the State Salmon Hatchery at Hat Creek into Pit River—the main tributary of the Sacramento—about 1,200,000 young salmon, and in the year 1887 over 5,000,000.

Having reference to the run of former years, and to salmon eggs obtained for propagation, and also Rainbow Trout eggs, we present the following table:

LAND-LOCKED SALMON.

Our Commission, on the seventeenth day of March, 1884, received from Mr. Atkins, Deputy United States Fish Commissioner, shipped from Brockport, Maine, a box containing 30,000 eggs of this species. The eggs reached the State Trout Hatchery at Shebley's Station in good condition, and were hatched with a loss of only seven and one half per cent. They were mainly distributed in the following lakes:

Bigler	15,000
Donner	5,000
Webber	5,000

Some small plants were made by former Commissioners. The fish increased and thrived. Many large ones have been captured during the last and the present year. The Commissioners hope to be able during the coming year to make generous plants of this much valued fish in other favorable localities.

SHAD.

The Pacific Coast is amply stocked with this species of fish. The increase in California has been marvelous. Millions are annually hatched in the overflows or tule lakes. The supply equals, if it does not exceed, the demand. Whilst as an edible fish it may not rival its eastern relations, in number and size it is victor. In the East a six-pounder is a very large specimen; here we take them that avoirdupois eight to ten pounds. It is estimated that more than a million of good sized shad have been taken from the waters of California during the present year.

We note here, for careful consideration, the fact that the yearly actual value of shad to the State is many times greater than all of the money that has been expended by the State "for the restoration and preservation of fish."

CARP.

Carp culture since May, 1877, at which time three hundred and forty-five were brought over from Germany to the United States, has been extensively and successfully prosecuted in nearly all the States of the American Union and in Her Majesty's Dominions. The progeny of the three hundred and forty-five has run into billions, and the increase continues. Carp has generally been received with great favor, and has in that respect more than equaled the demand for catfish. Carp were planted in California by favor of the United States Commission, December 19, 1879. Here they found congenial homes and favorable water, diet, and climatic conditions, and the family has become as large, if not larger, than that of any species of fresh water fish.

In 1872, on private account, eight carp of a choice variety were brought into this State from Hamburg, Germany. Their increase was prolific and widely distributed. Up to 1884 there was a strong desire among farmers and landholders to procure carp for stocking natural and artificial ponds and sloughs. Calls were covered with ample supplies, and private preserves, ponds, sloughs, swamps, still and sluggish waters, all over the State were filled with them. Since 1884 but few calls have been received. The supply is enormous—market value at times one and one half cents per pound.

CATFISH.

The seventy-four catfish imported from the Raritan River in 1874, have increased and multiplied and the increase distributed, until now, we believe there is no county in the State, from Del Norte to San Diego, that has not been supplied with a greater or less number of these fish. They are regularly sold in all the markets at the same prices as other abundant fish. They are admirably adapted to the sloughs and warm waters of the great valleys, and in them have so multiplied as to furnish a large supply of food. The aggregate value of this fish annually sold in the markets of San Francisco and Sacramento more than equals the appropriation annually made by the State for fish culture. Catfish are coming more into favor with citizens as food, and by a large class of consumers are preferred to the carp. The planting of these fish was regretted by many and approved by more. They have thriven wonderfully and need no protection. They cannot be exterminated.

STURGEON.

In our last biennial report we stated with regret that the catch of the year 1883, of this, one of the best and cheapest food fishes, had fallen short fully fifty per cent below the takes of the previous two or three years, and we attributed the cause to the indiscriminate and criminal slaughter made by Chinamen and other fishermen. Our river patrol has often raided the vandals and measurably stopped their murderous work, and we are permitted now to report, that during the last and present year, the increase of sturgeon has been satisfactory, and great numbers of very large size have been taken, and that indications point to a heavy increase in the year 1887. The sturgeon is not only a cheap, but it is also a favored food with all classes of our citizens, and is well advertised in "bills of fare" as the "steak of sole."

PERCH.

The Sacramento perch is regarded by many who claim to be good judges, as the best flavored and most palatable fish found in the inland waters of California. The following excerpt, from page 405 of Section I, Natural History of Useful Aquatic Animals, published under the auspices of the United States Commission of Fish and Fisheries, relating to this delicious fish, does injustice to it and to its epicurean friends:

> This species is known only by the name of "perch." * * * It has been thus far found only in the Sacramento and San Joaquin Rivers and tributaries. It is abundant in the lower parts of these rivers, large numbers being shipped to the market in San Francisco. It is there bought and consumed mainly by the Chinese, who value it highly, paying for it more than any other fish which they consume. Although it is an excellent pan-fish, very similar to the black bass, we have never seen any of them bought by Americans.

In our last report we complained of the scarcity of this species of fish, and attributed it in part to the covering of its spawn by sediment and to the drain upon the supply by Chinese and other fishermen, and we recommended the enactment of a law "to protect them from seine fishing for at least two years;" albeit there has been during the last two years a steady and gratifying increase in the catch of perch. During most of the time, and especially during the months of August, September, and October, our markets have been well supplied. The perch obtained from Tulare Lakes have sized well, and have been of most excellent quality. In 1885, Mr. Flockman caught and sold from Big Lake, in Yolo County, over thirty thousand pounds. Washington, Fisherman, and other small lakes are well stocked and have yielded a good harvest.

DACE.

But few of this species are now caught in the lower Sacramento River. This no doubt is owing in part to the fact that for several years past the waters of the river has been heavily charged with slickens or debris. This fish seeks clear water, and higher up the streams where the water is pure, they are caught in large numbers. The dace is a native of our rivers and waters. They are similar in shape to the pike, but different in color, being of a yellowish brown on the back and a dingy white on the sides and belly.

PIKE.

This fish has increased to a considerable extent in most of the waters of the State. During the last two years the increase has been about forty per cent, and promises to continue. They ascend the rivers higher than most other kinds of river fish and thus escape the fishermen's nets and snares. The run commences with the channel pike in the month of December, and with the bar or school pike in the month of March.

CHUBS.

The chub, a strictly inland water fish, was captured in great numbers until a few years ago, when they began to decrease so rapidly that it was feared they would become extinct in the rivers. Within the last three years, however, there has been a marked increase, so much so, that they are to be found at most any time of the year in our interior markets. Our mountain lakes still hold them in great abundance, notwithstanding the fact that in some of the lakes (notably Webber), tons of dead ones have been beached, either destroyed by disease or by poisons. The chub is an excellent fresh water fish, the flavor is almost equal to that of the Sacramento River perch. The chief objection to it is that it is quite bony, yet the meat peels well. The river catch this year has been heavy and an ample future supply is assured.

TRUCKEE TROUT.

Two kinds of trout are found in the streams of the Truckee basin. The silver trout is the finest of the trout variety in California. They are beautifully marked, clipper built, gamy, and often pull the scales at twenty-five pounds. This most excellent food and sportive fish is taken in large numbers in Bigler, Donner, Webber, Independence, and other mountain lakes. Appreciating the value of this species of trout, our Commission has during its office-holding secured several hundred thousand silver trout eggs, which have been hatched at the Shebley station, and fairly distributed in the lakes and streams of the State.

The other kind is commonly known as the black trout. It is the opinion of many experienced fishermen that it should be classed as a land-locked salmon. They grow to a large size, often weighing from ten to fifteen pounds. They are excellent spawners and breeders. Large numbers come to our markets from the State of Nevada.

Our friends east of our State line are unwilling to lose their traffic in this kind of fish, and have barricaded their passage into California by placing impassable dams across the Truckee River. Whilst regretting the lack of good will and comity so manifested, our citizens are pleased to pay their neighbors royal prices in the way of tribute for this excellent table fish.

RAINBOW TROUT.

In the United States Commissioners Report, Section I, History of Aquatic Animals, page 475, mention is made of the Rainbow Trout as follows:

> This species is generally known as the "brook trout," "mountain trout," "speckled trout," "golden trout," and other evanescent names are also sometimes applied to it. It does not reach a weight of more than five or six pounds, so far as we know, and most of them are fingerlings from four inches to a foot in length, etc."

In California the name "rainbow trout" (sometimes called the McCloud) is applied to what is regarded to be a distinct trout family, coarse-scaled and distinctively marked. Mr. Rosevelt—a most careful observer—says that "the distinction between the McCloud River and the mountain trout are quite apparent to the eye," and "there are some differences in their habits;" that the mountain trout does not grow to more than one half the size of the McCloud River trout, and that when cooked there is a marked superiority in favor of the mountain trout. Certain it is that but one kind of trout has been found in the ponds of the United States Fish Commission on the McCloud.

Rainbow trout are taken in great numbers in nearly all of the tributaries of the Sacramento River. They seek spawning grounds high up on their favored streams, and in near proximity to the natural and impassable falls found near the headwaters of most mountain streams.

Other varieties, called "mountain trout," "brook trout," "speckled trout," etc., are found above these falls. The rainbow is neither a gamy nor a choice food fish. Entering, however, into family relations with other varieties, the hybrid is an improved get.

HARD-SHELL CLAMS.

These are found, not in large quantities however, in the Bay of San Francisco. A great many that are sold in the City of San Francisco are taken from the shoal waters in the neighborhood of Tomales. The catch amounts to about 100 boxes per day. They sell readily for $1 per gallon. There are also several other kinds sold in small quantities of which no account is kept. The average amount of hard-shell clams consumed annually is 27,604 gallons.

SOFT-SHELL CLAMS.

During the last few years soft-shell clams have been taken in great quantities. The spawn is supposed to have been brought to this coast with the eastern oyster. They have covered the flats surrounding San Francisco Bay. The number taken by bushels cannot be obtained, as they are marketed in San Francisco by the box, each box holding about two gallons of solid meat. Two hundred and fifty boxes or 500 gallons are consumed daily, making the annual consumption 156,500 gallons.

SEA TURTLE.

There has been quite a trade during the past two years in this most valuable shell fish. The markets have been well supplied by coast fishermen of San Diego and Santa Barbara Counties.

TERRAPIN

Are taken in all of the inland lakes and rivers of central California. They are in good demand at all times and in consequence of consumption, show a slight decrease from former years.

HALIBUT.

This fine fish has increased to such a degree that they are found on sale at all times, in the markets. They are taken along the entire coast, from San Diego to the Oregon line.

FLOUNDERS

Are caught in great numbers in all the bays of the State. There has been no perceptible decrease in this species of fish.

TURBOT.

There never have been any large catches made in the waters of this State of this species of flounders. More, however, have been taken within the last few years than formerly. A small increase is clearly noticeable in the market supply.

SOLES

Have been taken in considerable quantities within the last few years, showing a healthy gain.

SALT WATER FISH.

The Commission has not been able to obtain an accurate account of the quantity of fish of all kinds taken below San Francisco, owing to the fact that fishermen in that section often act in the capacity of marketmen. A large amount of fish is consumed in the City of Los Angeles—not less than 400,000 pounds annually. It is estimated, by fishermen competent to judge, that the consumption in San Diego County annually is 150,000 pounds. These estimates do not include the thousands of pounds annually caught by fishing parties below the Bay of San Francisco. All together, from estimates and data obtained, 4,337,991 pounds have been taken during the present year—a decrease of twenty-five per cent from the catch of the year preceding.

Below is given the amount of salt water fish, received by wholesale dealers, during the fiscal year commencing August 1, 1885, and ending July 31, 1886. It includes rock cod, codfish, barretta, shad, barracuda, sea bass, tomcod, flounders, soles, smelt, halibut, turbot, pompino, king fish, herring, white bait, sardines, and sea trout:

A. Pardini, Clay Street Market, San Francisco, 714,100 pounds.
A. Sylvester, Clay Street Market, San Francisco, 281,765 pounds.
S. Paladina, Clay Street Market, San Francisco, 573,100 pounds.
J. Tavolara, New Market, San Francisco, 117,520 pounds.
Joseph Catania, New Market, San Francisco, 737,600 pounds.
E. Antoni, wholesale dealer, San Francisco, 361,400 pounds.
J. H. Kessing, Clay Street Market, San Francisco, 274,420 pounds.
Sold in Chinese markets, of all kinds, about 300,700 pounds.

The following tabulated statement will serve to show the quantities of each species and the season of the year when most numerous:

SALT WATER FISH RECEIVED BY G. CAMILLONE, WHOLESALE FISH DEALER, CALIFORNIA STREET MARKET, SAN FRANCISCO, DURING THE LAST FISCAL YEAR, COMMENCING AUGUST 1, 1885, AND ENDING JULY 31, 1886.

August, 1885.		
Rock and codfish	13,310 pounds.	
Shad	240 pounds.	
Barracuda and bass	11,320 pounds.	
Tomcod	920 pounds.	
Flounder and sole	72,960 pounds.	
Smelt	12,400 pounds.	
Halibut	9,300 pouads.	
Turbot	1,100 pounds.	
Pampino	940 pounds.	
Barretta	1,100 pounds.	
Kingfish	2,140 pounds.	
		125,730 pounds.
September, 1885.		
Rock and codfish	1,940 pounds.	
Shad	40 pounds.	
Barracuda	1,600 pounds.	
Sea bass	16,100 pounds.	
Tomcod and smelt	10,100 pounds.	
Halibut	400 pounds.	
Flounder and sole	6,000 pounds.	
Turbot	600 pounds.	
Pampino	740 pounds.	
Barretta	12,100 pounds.	
Kingfish	18,100 pounds.	
Shad, small	6,700 pounds.	
		74,420 pounds.

October, 1885.		
Rock and codfish	16,300 pounds.	
Shad	200 pounds.	
Smelt	1,100 pounds.	
Barracuda	900 pounds.	
Tomcod and king	2,900 pounds.	
Herring	100 pounds.	
Bass	14,000 pounds.	
		35,500 pounds.
November, 1885.		
Rock and cod	1,400 pounds.	
Shad	2,000 pounds.	
Smelt	2,000 pounds.	
Barracuda	9,000 pounds.	
Tomcod and king	1,900 pounds.	
Herring	9,000 pounds.	
Barretta	6,700 pounds.	
Flounder and sole	9,600 pounds.	
		40,600 pounds.
December, 1885.		
Rock and codfish	600 pounds.	
Shad	12,000 pounds.	
Smelt	900 pounds.	
Barracuda	800 pounds.	
Flounder and sole	14,000 pounds.	
Herring	24,000 pounds.	
Bass	100 pounds.	
Tomcod	1,000 pounds.	
Kingfish	600 pounds.	
		54,000 pounds.
January, 1886.		
Rock, codfish, and perch	1,243 pounds.	
Flounder and sole	390 pounds.	
Tomcod, kingfish, and smelt	460 pounds.	
Herring	2,490 pounds.	
		4,583 pounds.
Rock, codfish, and perch	3,490 pounds.	
Barracuda and halibut	960 pounds.	
Flounder and sole	790 pounds.	
Tomcod, smelt, and kingfish	1,160 pounds.	
		6,400 pounds.
Rockfish and perch	1,340 pounds.	
Herring	21,160 pounds.	
Flounder and sole	690 pounds.	
Halibut and barracuda	370 pounds.	
		23,560 pounds.
Rockfish, flounder, and cod	690 pounds.	
Herring	27,670 pounds.	
Barracuda	340 pounds.	
		28,700 pounds.
Rockfish and perch	4,670 pounds.	
Flounder and sole	3,460 pounds.	
Tomcod and smelt	1,390 pounds.	
Halibut	970 pounds.	
Herring	1,800 pounds.	
		28,490 pounds.
Rock, codfish, and perch	2,496 pounds.	
Flounder and sole	346 pounds.	
Herring	39,490 pounds.	
Tomcod and smelt	290 pounds.	
		42,622 pounds.
February, 1886.		
Rock, codfish, and perch	9,496 pounds.	
Barracuda	490 pounds.	
Flounder and sole	12,560 pounds.	
Tomcod	3,720 pounds.	
Smelt	9,200 pounds.	
Herring	84,300 pounds.	
Turbot	320 pounds.	
Pampino	90 pounds.	
Prawns	140 pounds.	
Halibut	320 pounds.	
		120,636 pounds.

March, 1886.

Herring	3,420 pounds.	
Rock, codfish, and perch	11,630 pounds.	
Barracuda	760 pounds.	
Flounder and sole	19,620 pounds.	
Tomcod	49,340 pounds.	
Smelt	11,360 pounds.	
Halibut	1,390 pounds.	
Turbot	960 pounds.	
Pampino	1,390 pounds.	
Prawns	40 pounds.	
Kingfish	2,340 pounds.	
Barretta	1,190 pounds.	
Shad	12,920 pounds.	
		116,340 pounds.

April, 1886.

Rock and codfish	24,670 pounds.	
Shad	19,390 pounds.	
Barracuda	340 pounds.	
Tomcod	3,140 pounds.	
Flounder and sole	22,390 pounds.	
Smelt	20,190 pounds.	
Halibut	290 pounds.	
Turbot	90 pounds.	
Pampino	40 pounds.	
Kingfish	2,940 pounds.	
		93,480 pounds.

May, 1886.

Rock and codfish	17,340 pounds.	
Shad	9,600 pounds.	
Barracuda	4,390 pounds.	
Tomcod	6,460 pounds.	
Flounder and sole	29,400 pounds.	
Smelt	9,360 pounds.	
Halibut	1,490 pounds.	
Turbot	790 pounds.	
Pampino	390 pounds.	
Kingfish	1,340 pounds.	
Sea bass	940 pounds.	
		81,400 pounds.

June, 1886.

Rock and codfish	2,950 pounds.	
Shad	360 pounds.	
Barracuda	290 pounds.	
Tomcod	970 pounds.	
Flounder and sole	9,340 pounds.	
Smelts	390 pounds.	
Halibut	190 pounds.	
Turbot	790 pounds.	
Pampino	85 pounds.	
Barretta	1,190 pounds.	
Kingfish	2,340 pounds.	
Smelt	420 pounds.	
Sea bass	10,000 pounds.	
		29,315 pounds.

July, 1886.

Rock and codfish	12,420 pounds.	
Shad	140 pounds.	
Barracuda	90 pounds.	
Tomcod	310 pounds.	
Flounder and sole	6,160 pounds.	
Sea bass	32,490 pounds.	
Smelt	960 pounds.	
Halibut	690 pounds.	
Pampino	60 pounds.	
Barretta	12,740 pounds.	
Kingfish	1,410 pounds.	
Shad (small)	2,140 pounds.	
		71,610 pounds.

NETS AND SEINES.

During the year 1886 over three thousand men were engaged in salmon fishing. They used from fifty to sixty seines, and over nine hundred gill nets. Greeks and Italians being a large class of the fishermen, use all kinds of nets and seines, and take most of the herring, smelt, flounder, tomcod, rock cod, sardines, barracuda, and sea bass. Chinese fishermen catch most of the shrimp, sturgeon, crabs, and clams.

CHINESE SPOLIATIONS.

We learn from the reports of the United States Treasury Department that our export trade with China for the year ending June 30, 1885, amounted to $6,396,506. Evidently our importations are greatly in excess, probably as three is to one, over our exports. Be this as it may, California exportations bring no returns, except such trifling amounts as may be paid to shippers and carriers. The export trade from San Francisco is largely in the shape of dried and salted fish, and dried shrimps and shrimp shells. These are taken from our waters by Chinese using criminal methods, and in violation of our laws and as free of cost to them as if they were "to [our] the manor born." These shipments of *our* unmatured fish in China are annually worth over $3,000,000. Where comes in our compensation?

Deputy Fish Commissioner W. C. Jones, in letter of March 16, 1886, referring to the destruction of small fish by Chinamen, says: "I have seen on many occasions a vessel ladened with shrimps and small fish all from one camp, the vessel carrying one hundred and twenty-five tons. I have visited some forty camps during the last two and a half years, and have heard of the location of many others on San Pablo and San Francisco Bays. To give you a better idea, I have arrested as high as five junks at a time, and in each of them would be at least one ton of small fish and shrimps in each junk every six hours or every tide. I made an effort last Fall to get something like an estimate of the number of Chinese engaged in the fish traffic—not including those directly engaged in San Francisco, but merely those catching fish and preparing them for shipment—and there are between fifteen hundred and two thousand. Five to six are required to manage one junk and attend to the drying beds. Their nets are made stationary and it requires about one hour to haul them and dump the catch in the boat; that leaves them about five hours to assort, spread them out, and take care of those sufficiently dried. On one occasion, last Summer, the boss Chinaman told me that the shrimp and fish in a junk was worth about twenty dollars when prepared for market. By the facts above stated, you can see that the matter has been underestimated."

In letter to one of our Representatives in Congress, dated March 9, 1886, our Commission, in hopes of obtaining Congressional relief, presented this grievance and stated that "the people of California most earnestly demand that a law shall be passed at the present session of Congress that will, in effect, prohibit the exportation of shrimp and young fish by Chinese to China. If such a law be passed our citizens will have (and they are entitled to have) the food of the waters for themselves, and a most destructive vandal occupation will cease. The oft-repeated and serious complaint that fish food is becoming scarce in California furnishes a powerful reason why the Chinese exhaustion should cease, and the cause of the complaint be removed."

The Commission received words of encouragement but nothing more. The Commission will use its police power to remedy the evil, and to enforce obedience to our fish laws.

PATROL AND PROTECTION.

The present Commissioners on coming into office were alarmed at the excessive decrease in the salmon take and at the small catch of some other varieties of fish. Ascertaining that the diminution was largely owing to violation of the fish laws of the State, by Chinese and others, the Commissioners determined to employ upon bays and rivers a strong and active patrol police. We were compelled to do this, or to permit the laws of the State to be violated and our waters and citizens robbed. The Commissioners also believed it to be a vain work to stock waters for the mere gain of vandals and foreign exportation. The patrol system was inaugurated in the Fall of 1883, and up to the present time has done much excellent work. Chief W. C. Jones in one of his reports favorably says of it, "The best evidence I have to offer in the interest of the good accomplished by the river patrol, is the small amount of violations now being committed of the existing fish laws. It is a well known fact that prior to the establishment of an efficient patrol on the rivers and bays, fishermen carried on their unlawful business without restraint."

As to the necessity and efficiency of the patrol, no better or more convincing statement is required than to refer to the number of arrests and convictions that have resulted from the first day of August, 1883, to October 1, 1884.

That branch of the police service under Chief Jones, arrested, and in nearly all cases, convicted, one hundred and seventy-five criminal offenders. From these, fines in the sum of $2,000 were collected, and under the law, mostly distributed to informers and District Attorneys. In 1885–86, over six hundred were arrested and about four hundred and fifty convicted. During the present year, between April seventh and September eighteenth, Chief J. H. Harten arrested seventy. Many were convicted, fined, or in default of payment, jailed. Whilst these law violations and wrongs have been known to all, their magnitude has been realized by but few. The expense of this service, although it has been heavy, is a trifle in comparison with the beneficial results secured. The work should be kept up and strengthened.

MAINTAINING THE LAWS.

Having reference to public sentiment in favor of maintaining the laws, our Commission adopt, as applicable to our State, the views of the Commissioners of Fisheries of the State of New York, contained in report for the years 1883–1884, page 12:

> Allusion has been made to the decided change in public sentiment in regard to the work of the Fishery Commissioners. It is beginning to dawn upon the minds of a great many, hitherto opponents, that every citizen has a direct pecuniary interest in the matter of fish culture and protection. The stronger and more widespread it becomes, the sooner the aims and objects of the Commission will be realized. If the people can be educated up to the standard of believing what, to every reflecting, intelligent mind is a self-evident proposition, namely: that every citizen has an indisputable right to share in the fish products of this State, and that those who infringe the protective laws are defrauding them of a portion, or, perhaps, the whole, of their rightful dividend, antagonism to legislative appropriation would speedily cease, and in its stead there would be a strong popular demand for the providing of all the money needed to perfect the operations already begun. They should be taught to regard the individual who kills an edible fish out of season or by illicit means, at any time as a public enemy. Why not? Either act is unlawful; hence, the man who perpetrates it is a violator of law, and as clearly entitled to punishment as an offender of any other class.

STEAM LAUNCH.

An Act of the Legislature to authorize the Board of Fish Commissioners to construct a steam launch to aid in carrying out the purpose of said Board, passed in March, 1885. The sum of $4,000 was appropriated. In April, 1885, a contract was entered into with John W. Rock, Esq., of Sacramento, an experienced boat builder, for the construction of the steamer at the cost of $4,000. The plans and specifications called for a boat forty-six feet long, twelve feet breadth of beam, and six feet depth of hold, with a boiler of the best American iron, six feet long, five feet in diameter, with return flues. The engine a ten by ten cylinder, propeller shaft three and one half inches in diameter, with a forty-six inch propeller. The boat was completed on the twentieth day of August, 1885, and immediately put into patrol service. The necessity for the craft was considered and passed upon by the Legislature, and the State is now the owner. The "Governor Stoneman" is staunch and swift (having made twenty miles in an hour and ten minutes) and has already done and will hereafter do most excellent protective and patrol work.

SHEBLEY HATCHERY.

This hatchery was established in May, 1883. During that year there were hatched and distributed over 95,000 trout. In the year 1884 about 250,000. In the year 1885 about 150,000. During this year, up to the present time, over 100,000. The output for 1887 should not be less than 300,000. The trout distribution from Chabot for the two years preceding 1883 amounted to only 87,000. The maintenance cost of the hatchery at Chabot (condemned in 1883) was $250 per month; cost of the Shebley, $100 per month.

STATE SALMON HATCHERY.

In March, 1885, the Legislature passed a bill, authorizing the Board of Fish Commissioners to erect and maintain a State Salmon Hatchery, and appropriating therefor the sum of $10,000. Before entering upon the work of construction a majority of the Board personally examined the Little Sacramento River, McCloud, Pit, and Hat Creek, all tributaries of Sacramento River. On the twentieth day of April the Board selected a site, and secured ample domain and necessary water, timber, and other privileges. The station is upon Hat Creek, about two and one half miles above its junction with Pit River. The site is a most excellent and desirable one, for the following reasons: an assured supply of salmon spawn; abundance of pure, cold water; absolute security from freshets; convenient reservoir sites; excellence of seining grounds; abundance of timber; ample grades for water discharge; good public roads, etc.

The selection was also made from another and most important inducement. Pit River is only about one half a mile from the hatchery, and the spawn of both Hat Creek and Pit River (a noted salmon stream) can be readily handled and hatched in it. Work upon the building commenced in May last. Fred. White, Esq., of Sacramento, a skillful mechanic and builder, drafted the plan and superintended the construction. The building is 100 feet long, and 46 feet wide; framed and strongly tied; inclosed with planed rustic; well roofed, painted, and underpined. The inside furnishing consists of four large water tanks, and eight tiers of boxes or flumes, set on proper grade, and made to receive seventy propagating baskets to the tier. Two more tiers can be added, when required. Two storage ponds, convenient to the hatchery, have been constructed—one, 40x40 feet; the other, 8x60 feet. The young samlets will be held in these reservoirs, until acquired size and strength will enable them to defend themselves against larger fish and common enemies. 6,000,000 to 8,000,000 young fry can be hatched annually. At the present writing we have in the hatchery about 1,200,000 that will be released in December.

The expense of running the United States Salmon Hatchery at McCloud, covering a period of five years preceding January, 1883, was $53,000—(see Bulletin of the United States Fish Commissioners, page 202). The maintenance of the California State Salmon Hatchery should not exceed $3,000 per annum. The State is now the owner of a large, commodious, well furnished hatchery, and will not hereafter be called upon to pay questionable bills, aggregating thousands of dollars, for the hatching and release of salmon.

CANNERIES.

On account of the small run, and decreased take of salmon, more than one half of the canneries that were operated in 1883–4 were closed in 1885 and 1886. The number of cases packed in 1885 was 90,000, as against 120,000 for 1883, and 200,000 for 1882. In 1882, nineteen canneries were in successful operation, whilst in 1885, only five or six were running.

The closing of ten or twelve packing establishments was not only a serious loss to proprietors, but also to the large force of men employed by them; several thousands thereby lost remunerative employment.

The prospect for the pack of 1887 is not encouraging. Most of the canneries will remain closed, and one third or more of the boats will be unused. The pack on the Columbia River also shows a heavy shortage, as appears from the following statement taken from an Oregon financial and trade report: "The legal limit of the canning season on the Columbia River closed last Saturday night, but the canneries have not made up their reports. In a general way, the pack in that river is estimated at from 400,000 to 450,000 cases. Possibly the actual returns will not vary much from 425,000 cases, which means a shortage of 100,000 cases, as compared with last year." The salmon season on the Columbia River runs from April first to August first.

DAMS AND FISH LADDERS.

Many complaints have been made to the Commissioners from all portions of the State, that owners of dams have neglected to comply with the law requiring the construction of fishways, so as to permit the free passage of fish. Many of the old dams now obstructing the rivers, were originally built to divert water for mining purposes. The mining use having ceased, the parties who erected long since abandoned them. Other parties have come into possession and now use them for irrigation, but disavow ownership and deny any obligation to furnish them with fish ladders. Others are owned by persons who still claim them, but who are not residents of the county in which they are situated, and others are owned by unknown parties. Such surrounding conditions render it difficult and expensive to serve the necessary papers, and to obtain the desired relief. Other dams are upon rivers close to natural falls, and the distance between is too limited to be of any serious injury. In such a case both or neither should be furnished with fishways. The owners of dams upon whom we have served notices have generally either put in fish ladders or promised so to do.

LAWS RECOMMENDED.

The close season for salmon should be enlarged. It is now "between the thirtieth day of August and the first day of October." It should be from the first day of August to the first day of October.

A law should be passed prohibiting the use of what is called the "Chinese shrimp or bag net." This net does more damage to the fish interest of the State than all other nets and traps combined.

A law should be passed prohibiting the use of Chinese sturgeon lines at any time, and making the penalty severe for its violation.

The Commission earnestly recommends legislative remedial action to prevent the destruction of fish by seals and sea lions.

And further recommend the repealing of the shad close season law.

And further recommend that the penalties for the violations of fish laws be made uniform, and that fines collected be allotted as follows: one half to the informer, one quarter to the prosecuting District Attorney of the county in which the action is tried, one quarter to the State Board of Fish Commissioners, to be paid to the Treasurer of the Board.

APPROPRIATION AND EXPENSES.

The sum of $5,000 per year has heretofore been appropriated "for the restoration and preservation of the fish of the State." This sum was devoted by former Commissioners mostly in the securing and hatching of fish eggs, and in the distribution of young fish.

Extensively, as heretofore, the work of preservation and restoration has been kept up by the present Board. Since the coming in of the present Commission its work has been necessarily enlarged, and its expenses greatly increased. In August, 1883, a system of police patrol of the rivers and bays was established, and has been annually kept up, and should be continued. In March, 1885, a steam launch became an arm of the police service. The maintenance of the patrol, including the operative expenses of the steamer, has greatly increased the expenditures of the Commission, and the draft thereby occasioned upon the $5,000 fund leaves but little of it for other important uses.

The efficient and successful management of the State Salmon Hatchery, since its construction in 1885, has devolved upon the Commission. We estimate that the cost of operating it will be about $3,000 a year. This figure, in comparison with the annual expenditure of the United States Commission, of $10,000 per year on the McCloud, we think is reasonable. In order to cover the cost of propagation and replenishment, the police service and steamer, two extensive hatcheries (a salmon and trout), the meetings of the Board, official work, traveling and incidental expenses, the sum of $10,000 a year is required, and should be appropriated.

SEALS AND SEA LIONS.

These aquatic animals are a serious detriment to the fish interests of the State. They sit at the entrance of the Golden Gate as royal toll gatherers, and take the lion's share of the schools of the finny tribe, as they pass from the broad Pacific into the Bay of San Francisco, preparatory to an ascent of our rivers. In the opinion of the Commission, they are great destroyers of the salmon. They appear to be more numerous at Seal Rock, and around the entrance of San Francisco Bay, than in former years, owing, no doubt, to the fact that the fishermen have driven them with their nets from Suisun and San Pablo Bays. They not only guard the entrance of San Francisco Bay, but are found at the entrance of Monterey, Bolenas, Point Arena, Tomales, and Shoalwater Bays. This and former Commissions, and the public press, have repeatedly invoked legislative action to prevent the immense destruction of fish constantly going on and increasing by these worthless animals. It is highly important to our citizens to have the food of which they are so deprived, and in their behalf remedial legislation is again urgently demanded.

THE SACRAMENTO RIVER.

The Sacramento, the largest river in the State, runs from north to south through the counties of Modoc, Lassen, Shasta, Tehama, Butte, Colusa, Sutter, Yolo, Sacramento, and Solano, a distance of nearly five hundred miles. It has its origin from the springs and melting snows of the mountains, and, as it drains an immense area during protracted and heavy rains, it overflows its banks and floods a large area of lowlands along the lower part of its course. The river is a pure, clear stream above the mouth of the Feather, but below that point it is heavily charged with detritus from the mining districts, the streams flowing from which are tributary to the Feather. The water in the mountains is cold, while in the lower reaches during the Summer months it gets quite warm, reaching at times a temperature of eighty degrees.

COMPARATIVE TEMPERATURE OF THE RIVER.

Below is given the temperature of the water in the Sacramento River at Sacramento, taken at 4 o'clock P. M. daily, by Thomas Evans, day watchman of the Central Pacific Railroad, for the Fish Commission, from September 15, 1885, to September 15, 1886:

September 15, 1885	72 degrees.
September 16, 1885	72 degrees.
September 17, 1885	71 degrees.
September 18, 1885	71 degrees.
September 19, 1885	71 degrees.
September 20, 1885	72 degrees.
September 21, 1885	73 degrees.
September 22, 1885	73 degrees.
September 23, 1885	71 degrees.
September 24, 1885	70 degrees.
September 25, 1885	70 degrees.
September 26, 1885	69 degrees.
September 27, 1885	69 degrees.
September 28, 1885	69 degrees.
September 29, 1885	68 degrees.
September 30, 1885	68 degrees.
October 1, 1885	68 degrees.
October 2, 1885	69 degrees.
October 3, 1885	70 degrees.
October 4, 1885	70 degrees.
October 5, 1885	70 degrees.
October 6, 1885	68 degrees.
October 7, 1885	67 degrees.
October 8, 1885	67 degrees.
October 9, 1885	66 degrees.
October 10, 1885	66 degrees.
October 11, 1885	66 degrees.
October 12, 1885	64 degrees.
October 13, 1885	64 degrees.
October 14, 1885	63 degrees.
October 15, 1885	63 degrees.
October 16, 1885	63 degrees.
October 17, 1885	62 degrees.
October 18, 1885	63 degrees.
October 19, 1885	63 degrees.
October 20, 1885	62 degrees.
October 21, 1885	61 degrees.
October 22, 1885	61 degrees.
October 23, 1885	61 degrees.
October 24, 1885	61 degrees.
October 25, 1885	61 degrees.
October 26, 1885	61 degrees.
October 27, 1885	61 degrees.
October 28, 1885	61 degrees.
October 29, 1885	61 degrees.
October 30, 1885	61 degrees.
October 31, 1885	61 degrees.
November 1, 1885	60 degrees.
November 2, 1885	59 degrees.
November 3, 1885	58 degrees.
November 4, 1885	56 degrees.
November 5, 1885	55 degrees.
November 6, 1885	54 degrees.
November 7, 1885	54 degrees.
November 8, 1885	56 degrees.
November 9, 1885	54 degrees.
November 10, 1885	53 degrees.
November 11, 1885	52 degrees.
November 12, 1885	52 degrees.
November 13, 1885	51 degrees.
November 14, 1885	51 degrees.
November 15, 1885	51 degrees.
November 16, 1885	51 degrees.
November 17, 1885	52 degrees.

November 18, 1885	51 degrees.
November 19, 1885	51 degrees.
November 20, 1885	50 degrees.
November 21, 1885	50 degrees.
November 22, 1885	49 degrees.
November 33, 1885	49 degrees.
November 24, 1885	48 degrees.
November 25, 1885	48 degrees.
November 26, 1885	48 degrees.
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December 28, 1885	46 degrees.
December 29, 1885	46 degrees.
December 30, 1885	46 degrees.
December 31, 1885	45 degrees.
January 1, 1886	44 degrees.
January 2, 1886	43 degrees.
January 3, 1886	42 degrees.
January 4, 1886	41 degrees.
January 5, 1886	41 degrees.
January 6, 1886	41 degrees.
January 7, 1886	41 degrees.
January 8, 1886	41 degrees.
January 9, 1886	41 degrees.
January 10, 1886	41 degrees.
January 11, 1886	40 degrees.
January 12, 1886	40 degrees.
January 13, 1886	42 degrees.
January 14, 1886	42 degrees.
January 15, 1886	42 degrees.
January 16, 1886	43 degrees.
January 17, 1886	43 degrees.
January 18, 1886	42 degrees.
January 19, 1886	43 degrees.
January 20, 1886	43 degrees.
January 21, 1886	47 degrees.
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July 11, 1886	77 degrees.
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July 13, 1886	80 degrees.
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September 5, 1886	71 degrees.
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September 8, 1886	73 degrees.
September 9, 1886	74 degrees.
September 10, 1886	73 degrees.
September 11, 1886	73 degrees.
September 12, 1886	72 degrees.
September 13, 1886	71 degrees.
September 14, 1886	71 degrees.
September 15, 1886	71 degrees.

THE AMERICAN RIVER.

The American is a shallow, muddy stream and empties into the Sacramento at Sacramento City. But few fish are found in the lower part of the stream. Trout are found in some of its branches above the mining districts—notably Silver Creek and the Rubicon. This river, prior to placer mining, was one of the best salmon streams in the State. Of late years no salmon have ascended it.

THE YUBA RIVER.

The Yuba is a branch of the Feather River. It is a shallow stream, except during the rainy season. Considerable mining is carried on in its bed and along its banks, and its water is muddy. Trout are found in its headwaters above the mining districts.

BEAR RIVER.

Bear has lost all claim to the name of river. Above the town of Wheatland it has lost its channel and volume as a Summer stream. It never was noted as a fish stream, although a few salmon and perch were taken from its waters in early days.

THE SAN JOAQUIN RIVER.

The San Joaquin, once a noted salmon stream; of late years few salmon have been taken in its waters. The principal cause of abandonment is the great number of dams upon its various branches, which are so constructed as not to allow the fish to reach their spawning grounds. Salmon and other varieties of fish are taken in considerable quantities near the mouth of the river. Most of the fishing in this stream is done below the city of Stockton.

THE TUOLUMNE RIVER.

The Tuolumne, a branch of the San Joaquin, at one time was one of the best salmon streams in the State. Salmon have not ascended the stream for some years.

THE STANISLAUS RIVER.

What has been said of the Tuolumne is true of the Stanislaus. Occasionally a salmon may be seen trying to get over one of its numerous dams.

COAST RIVERS AND CREEKS.

Smith River, in the county of Del Norte, with its north and south forks, makes a large stream. It has a regular run of salmon and is also well stocked with salmon and brook trout.

The next stream south of the Smith of any consequence is the Klamath. This is an excellent salmon stream, not fished, however, to any great extent. The time is close at hand when it will have its share of fishing camps and canneries.

Trinity River, owing to the debris from the placer mines in that section, does not amount to much as a fishing stream. The fish will not ascend a stream to spawning grounds through water heavily charged, as this is, with mining detritus.

Redwood Creek and Mad River are not much fished, notwithstanding the fact that salmon and trout abound in them.

Eel, one of the principal rivers running through Humboldt County, is a large stream and has many fishing camps upon its banks, in which large quantities of salmon are salted annually.

Mattole River and Casper Creek are comparatively small streams. They are well stocked with fish.

A great many salmon are taken in Little River and shipped to San Francisco, where they are known as coast salmon.

The same can be said of the Navarro River in Mendocino County.

Russian, the longest river running through Sonoma County, is a good fish stream. There are several camps upon its banks near its mouth, and vast quantities of fish are taken in its waters. Its best fish is the salmon, perch, pike, and chub.

San Lorenzo, Benito, and Soquel Creeks, are about the only streams of any consequence in Santa Cruz County. Several smaller streams empty into Monterey Bay. At times salmon run in them, but never in great quantities. These are the most southerly streams entered by salmon, being between latitude thirty-six degrees and thirty-seven degrees north, and are the lowest salmon streams on either the Atlantic or Pacific Coast.

In the rivers and creeks of Monterey, San Luis Obispo, Santa Barbara, Ventura, Los Angeles, and San Diego, no salmon enter to speak of, but salmon trout are taken in large quantities.

EXPENDITURES DURING THE THIRTY-SIXTH FISCAL YEAR.

To Appropriation.			
General Appropriation Bill, Stats. of California, 1883 (p. 76)			$5,000 00
By Expenditures.			
Warrant No. 537—To J. C. Frazier, salary and expenses	$194 80		
To W. C. Jones, salary and expenses, July	240 00	$434 80	
Warrant No. 1839—To J. Shebley, cash and labor	$168 10		
To E. Bosqui, engraving and printing	25 00		
To W. C. Jones, salary and expenses, August	600 00		
To R. H. Buckingham, traveling expenses, supplies, etc.	144 65	937 75	
Warrant No. 3088—To J. C. Frazier, salary and expenses, September	$247 95		
To W. C. Jones, salary September and October	160 00		
To R. H. Buckingham, traveling expenses, supplies, etc.	98 35	506 30	
Warrant No. 3095—To A. B. Dibble, traveling expenses, supplies, etc.		365 04	
Warrant No. 3547—To W. C. Jones, salary November	$80 00		
To J. C. Frazier, salary and expenses October	101 75		
To W. E. Doan, clerical work	40 00		
To T. H. Wilhelm, meat	32 00	253 75	
Warrant No. 4446—To Wm. Irelan, analysis of water	$20 00		
To R. H. Buckingham, traveling and other expenses	65 78		
To W. C. Jones, salary December	80 00		
To Shaw & Son, 100,000 salmon eggs	65 00	230 78	
Warrant No. 6279—To W. C. Jones, salary January	$80 00		
To Jos. Shebley, labor, expressage, etc.	211 86		
To A. B. Dibble, traveling expenses, supplies, etc.	329 10	620 96	
Warrant No. 8723—To J. Shebley, salary and expenses January	$306 10		
To J. C. Frazier, salary and expenses December	24 48		
To W. C. Jones, salary February	80 00		
To R. H. Buckingham, traveling expenses, supplies, etc.	170 40		
To A. B. Dibble, traveling expenses, supplies, etc.	189 25	770 23	
Warrant No. 9595—To W. C. Jones, salary March and April	$160 00		
To S. P. Maslin, clerical work	100 00		
To A. B. Dibble, traveling expenses, supplies, etc.	160 60	420 60	
Warrant No. 7—To R. H. Buckingham, traveling expenses, supplies, etc.	$51 95		
To H. Woodson, 100,000 trout eggs	195 75		
To Wells, Fargo & Co., expressage	29 75	277 45	
Warrant No. 341—To W. C. Jones, salary June		80 00	
Warrant No. 352—To J. Shebley, traveling and expressage		46 60	
Warrant No. 353—To J. C. Frazier, salary December and expenses	$240 90		
Less deficiency in appropriation	55 74	185 16	
			5,000 00

EXPENDITURES

During the Thirty-seventh Fiscal Year, chargeable against the Appropriation for the Restoration and Preservation of Fish within the waters of the State.

To appropriation (General Appropriation Bill, Statutes California, 1885, page 85)			$5,000 00
By Expenditures.			
Warrant No. 354—To A. & D. E. Matteson, laying cement pipe	$41 50		
To Stevens & McKenny, 362,580 trout eggs	365 78		
To A. W. Coffin, freight on fish	65 00		
To J. Shebley, labor, etc.	100 00		
To Wm. Shebley, expressage, etc.	82 85		
To Wells, Fargo & Co., expressage	32 40		
		$687 53	
Warrant No. 737—To A. B. Dibble, traveling expenses, supplies, etc.		99 00	
Warrant No. 796—To W. C. Jones, salary July and expenses, 1885		105 00	
Warrant No. 1818—To R. H. Buckingham, traveling expenses, etc.		286 75	
Warrant No. 1819—To W. C. Jones, salary August, etc., 1885	$300 00		
To Goodall, Perkins & Co., 500 gallons water	2 50		
To Holbrook, Merrill & Stetson, hardware	45 99		
		348 49	
Warrant No. 2106—To Huntington, Hopkins & Co., hardware	$51 19		
To J. N. Gill, provisions	26 36		
		77 57	
Warrant No. 2108—To S. P. Maslin, clerical services		100 00	
Warrant No. 2415—To Sherburn & Smith, crockery	$21 00		
To E. Canberry, labor	5 00		
To Standard Oil Company, oil	4 88		
To E. N. Eager, survey of San Pablo Bay	40 00		
To W. Shebley, labor, etc.	90 63		
		161 51	
Warrant No. 2761—To Marchutz & Cantrell, propeller		27 80	
Warrant No. 3206—To R. H. Buckingham, traveling expenses, supplies, etc.	$148 85		
To A. Caldero, board, etc.	5 00		
To R. E. Hansen, pilot	30 00		
To A. B. Dibble, traveling expenses, supplies, etc.	125 50		
To Black Diamond Mining Company, coal	35 30		
To W. C. Jones, provisions	31 85		
To W. H. Dewey & Co., provisions	106 18		
To pay-roll September and October, 1885	885 00		
		1,367 68	
Warrant No. 4019—To W. C. Jones, provisions	$22 60		
To Thos. Summers, engineer	27 00		
To Marchutz & Cantrell, propeller	67 00		
To E. M. Leitch, coal	42 25		
To Peter Johnson, hardware	15 70		
To W. H. Dewey & Co., provisions	108 14		
		282 69	
Warrant No. 4214—To Huntington, Hopkins & Co., packing	$5 67		
To Peter Torillo, labor	10 50		
To Black Diamond Mining Company, coal	13 45		
To W. C. Jones, traveling expenses	50 75		
To A. B. Dibble, traveling expenses, supplies, etc.	113 55		
To W. H. Dewey & Co., provisions	26 27		
To pay-roll, November	176 00		
		396 19	
Warrant No. 5294—To Huntington, Hopkins & Co., oars	$2 00		
To Root, Neilson & Co., machine work	4 10		
To John Cropper, labor, December	30 00		
To R. H. Buckingham, traveling expenses, supplies, etc.	89 30		
To S. P. Maslin, clerical work	38 00		
		163 40	
Amount carried forward		$4,103 61	$5,000 00

Expenditures—Continued.

Amount brought forward		$4,103 61	$5,000 00
Warrant No. 5580—To A. B. Dibble, traveling expenses, supplies, etc.		114 70	
Warrant No. 5813—To W. C. Jones, salary December, etc.		90 00	
Warrant No. 5814—To Wm. Shebley, salary September to December	$390 00		
To John Cropper, salary January	30 00		
To A. B. Dibble, traveling expenses, supplies, etc.	77 65		
To R. H. Buckingham, traveling expenses, supplies, etc.	53 85		
		551 50	
Warrant No. 6442—To Sacramento Transfer Company, 3 tons coal	$36 00		
To A. B. Dibble, traveling expenses, supplies, etc.	71 80		
To pay-roll, February	71 50		
	$179 30		
Less deficiency in approprintion	39 11		
		140 19	
			5,000 00

DEFICIENCIES

Incurred during the Thirty-sixth and Thirty-seventh Fiscal Years, chargeable against the Appropriation for the Restoration and Preservation of Fish within the waters of the State.

Thirty-sixth Fiscal Year.		
Warrant No. 353		$55 74
To W. C. Jones, salary, May		80 00
Thirty-seventh Fiscal Year.		
Warrant No. 6442	$39 10	
To R. H. Buckingham, traveling expenses, etc.	80 00	
To J. Shebley, salary June, 1886	86 66	
To J. H. Hartin, expenses April, May, and June	294 50	
To A. B. Dibble, traveling expenses, supplies, etc.	288 94	
		789 10
		$924 84

EXPENDITURES

In the Erection and Maintenance of a State Salmon Hatchery, incurred during the Thirty-sixth Fiscal Year.

To appropriation (Statutes of California, 1885, page 31)			$10,000 00
By Expenditures.			
Warrant No. 9615—To R. H. Buckingham, traveling expenses selecting site for hatchery	$447 55		
To A. B. Dibble, traveling expenses selecting site	238 05		
		$715 60	
Warrant No. 9789—To T. C. Ten Eick, teaming	$182 00		
To Murcken & Knoch, lumber	47 27		
To Hat Creek Mills, lumber	167 51		
To Florin Brothers, supplies	926 49		
To T. Millward, fish spear	2 50		
To J. L. Chadderdon, oil	15 00		
To Standard Oil Company, paints and oil	26 77		
To Sacramento Lumber Company, lumber	207 65		
To Sherburn & Smith, crockery, etc.	252 85		
To Hall, Luhrs & Co., provisions	134 72		
To Charles Zeitler, hardware	397 25		
		2,360 01	
Balance on hand July 1, 1885		6,924 39	
			10,000 00

EXPENDITURES

In the Erection and Maintenance of a State Salmon Hatchery, incurred during the Thirty-seventh Fiscal Year.

To Appropriation.			
Balance on hand July 1, 1885			$6,924 39
By Expenditures.			
Warrant No. 8—To M. Knoch, supplies to hatchery	$81 73		
To J. F. Bowman, supplies to hatchery	41 39		
To H. Schnittger, supplies to hatchery	31 65		
To F. L. White, supplies to hatchery	16 90		
To pay-roll, April and May	713 50		
		$885 17	
Warrant No. 340—To F. L. White, supplies	$37 50		
To Merchen & Knoch, supplies	10 55		
To H. Schnittger, supplies	18 50		
To Huntington, Hopkins & Co., seine net	63 75		
To Dennis & Fitzwater, supplies	43 35		
To labor pay-roll, June and July	518 83		
		692 48	
Warrant No. 355—To R. H. Buckingham, traveling expenses, supplies, etc.	$130 90		
To C. W. Pierce, teams and board	53 50		
To Bidwell Brothers, provisions	91 29		
		275 69	
Warrant No. 797—To Dennis & Fitzwater, provisions	$88 66		
To A. B. Dibble, traveling and other expenses	397 90		
To labor pay-roll, July and August	500 00		
To H. Schnittger, supplies	15 70		
To Murcken & Knoch, supplies	11 99		
To F. L. White, supplies	24 58		
		1,039 60	
Warrant No. 1820—To Lion Insurance Company, insurance on hatchery	$48 00		
To A. B. Dibble, traveling expenses, supplies, etc.	208 65		
To F. L. White, freight and supplies	96 30		
To J. McArthur, supplies	17 68		
To H. Schnittger, supplies	16 86		
To Florin Brothers, lumber and supplies	41 80		
To Murcken & Knoch, supplies	44 17		
To Dennis & Fitzwater, supplies	87 53		
To pay-roll, August	514 00		
		1,074 98	
Warrant No. 2107—To Huntington, Hopkins & Co., pipes, etc.		179 83	
Warrant No. 2416—To California Wire Works, wire cloth		400 05	
Warrant No. 2762—To Huntington, Hopkins & Co., hardware	$60 83		
To Dennis & Fitzwater, provisions	55 92		
To J. Dungan, lumber	8 64		
To H. Schnittger, provisions	27 70		
To Murcken & Knoch, provisions	33 69		
To F. L. White, provisions	80 00		
To pay-roll, September	557 20		
		823 98	
Warrant No. 3202—To R. H. Buckingham, traveling expenses, supplies, etc.	$90 55		
To M. R. Rose, bridge bolts	11 87		
		102 42	
Warrant No. 3729—To Black Diamond Mining Company, coal	$52 20		
To D. H. Woods, labor	150 00		
To Florin Brothers, supplies	8 00		
To S. T. Dibble, labor	38 33		
To Murcken & Knoch, supplies	16 34		
To Huntington, Hopkins & Co., hardware	2 52		
To pay-roll, October	374 33		
		641 72	
Amount carried forward		$6,115 92	$6,924 39

EXPENDITURES—Continued.

Amount brought forward		$6,115 92	$6,924 39
Warrant No. 4020—To Dennis & Fitzwater, provisions		57 60	
Warrant No. 4213—To C. W. Pierce, teams and board	$54 00		
To Murcken & Knoch, supplies	15 96		
To A. B. Dibble, traveling expenses, supplies, etc.	156 00		
To Bidwell Brothers, supplies	92 62		
To pay-roll, November	120 00		
		438 58	
Warrant No. 5292—To Fall River Mills, lumber	$8 98		
To Murcken & Knoch, supplies	77 80		
To Dennis & Fitzwater, supplies	31 75		
To pay-roll, December	103 25		
To S. P. Maslin, salary April to August	105 00		
	$371 78		
Less deficiency	59 49		
		312 29	
			6,924 39

DEFICIENCY

Incurred during the Thirty-seventh Fiscal Year, chargeable to the Appropriation for the Construction and Maintenance of a State Salmon Hatchery.

Warrant No. 5292—To deficiency		$59 49
Warrant No. 5815—To Bush & Johnson, freight	$15 55	
To Dennis & Fitzwater, supplies	25 40	
To Murcken & Knoch, supplies	9 78	
To pay-roll, January	120 00	
		170 73
Warrant No. 6439—To Huntington, Hopkins & Co., hardware	$14 20	
To H. Schnittger, provisions	8 05	
To Dennis & Fitzwater, provisions	46 28	
To I. N. Gill, supplies	17 98	
To Murcken & Knoch, supplies	16 87	
To pay-roll, February	115 67	
		219 05
Warrant No. 6834—To S. P. Maslin, salary January and February		60 00
Warrant No. 7000—To Murcken & Knoch, supplies	$81 67	
To pay-roll, March	151 40	
		160 07
Warrant No. 7724—To S. P. Maslin, salary March and April		60 00
To Dennis & Fitzwater, provisions	$92 94	
To Murcken & Knoch, supplies	23 35	
To H. Schnittger, supplies	9 55	
To Florin Bros., lumber	20 46	
To S. P. Maslin, salary May and June	60 00	
To T. M. Buckingham, labor April, May, and June	120 00	
To W. R. Dibble, labor April, May, and June	120 00	
To W. O. Cropper, labor April, May, and June	120 00	
To John Cropper, labor April, May, and June	90 00	
		656 30
Deficiency incurred in the erection and maintenance of a State Salmon Hatchery		$1,385 64

EXPENDITURES INCURRED IN THE CONSTRUCTION OF A STEAM LAUNCH.

To appropriation (Statutes of California, 1885, page 124)		$4,000 00
Warrant No. 15—To J. W. Rock, first payment on contract	$1,330 00	
Warrant No. 16—To J. W. Rock, second payment on contract	1,330 00	
Warrant No. 1492—To J. W. Rock, third payment on contract	1,340 00	
		4,000 00
To J. W. Rock, alteration made on steam launch		595 00

Note.—This deficiency of $595 was authorized to be created by the State Board of Examiners September 4, 1885.

Respectfully submitted.

R. H. BUCKINGHAM,
A. B. DIBBLE,
T. J. SHERWOOD,
Commissioners of Fisheries.

LIST OF FISH COMMISSIONERS.

UNITED STATES.

Prof. Spencer F. Baird	Washington, D. C.

ALABAMA.

Col. D. R. Hundley	Madison.
Hon. Charles S. G. Dorster	Prattville.

ARIZONA.

Hon. J. J. Gosper	Prescott.
Hon. Richard Rule	Tombstone.
J. H. Taggart, Business Manager	Yuma.

ARKANSAS.

J. E. Reardon	Little Rock.
J. H. Hornibrook	Little Rock.
H. H. Rottaken	Little Rock.

CALIFORNIA.

R. H. Buckingham, President	Sacramento.
T. J. Sherwood	Marysville.
A. B. Dibble, Secretary and Treasurer	Grass Valley.

COLORADO.

Wilson E. Sisty	Idaho Springs.

CONNECTICUT.

Dr. W. M. Hudson	Hartford.
James A. Bill (term expires August 26, 1887)	Middletown.
Robert G. Pike (term expires March 8, 1889)	Lyme.

DELAWARE.

Enoch Moore, Jr.	Wilmington.

GEORGIA.

Hon. T. J. Henderson	Atlanta.
Dr. H. H. Cary, Superintendent of Fisheries	Le Grange.

ILLINOIS.

N. K. Fairbank, President	Chicago.
Maj. George Breuning	Centralia.
S. P. Bartlett, Secretary	Quincy.

INDIANA.

Enos B. Reed (term expires in 1887)	Indianapolis.

IOWA.

E. D. Carlton	Spirit Lake.

KANSAS.

S. Fee	Warnego.

KENTUCKY.

William Griffith, President	Louisville.
P. H. Darby	Princetown.
John B. Walker	Madisonville.
Hon. C. J. Walton	Munfordville.
Hon. John A. Steele	Versailles.
W. C. Price	Danville.
Dr. Wm. Van Antwerp	Mount Sterling.
Hon. M. J. Chambers	Independence.
A. H. Goble	Collettsburg.
J. H. Malory	Bowling Green.

MAINE.

E. M. Stilwell, Henry O. Stanley,	Commissioners of Fish and Game	Bangor. Dixfield.
B. W. Counce,	Commissioner of Sea and Shore Fisheries	Thomaston.

MARYLAND.

G. W. Delewader	Oakland.
Dr. E. W. Humphries	Salisbury.

MASSACHUSETTS.

E. A. Brockett	Winchester.
F. W. Putnam	Cambridge.
E. H. Lathrop	Springfield.

MICHIGAN.

Dr. J. C. Parker, President	Grand Rapids.
A. J. Kellogg	Detroit.
Herschel Whitaker	Detroit.
W. D. Marks, Superintendent	Paris.

MINNESOTA.

Daniel Cameron	La Cresent.
Wm. M. Swerney	Red Wing.
Robert Ormsby Sweeney	St. Paul.
S. S. Walkins, Superintendent	Red Wing.

MISSOURI.

J. G. W. Studman	280 Pine Street, St. Louis.
Gen. J. L. Smith	Jefferson City.
H. M. Garliech	St. Joseph.

NEBRASKA.

W. L. May	Fremont.
B. E. B. Kennedy	Omaha.
R. R. Livingston	Plattsmouth.

NEVADA.

W. M. Cary	Carson City.

NEW HAMPSHIRE.

Geo. W. Riddle	Manchester.
E. B. Hadge, Superintendent	Plymouth.
John H. Kimball	Marlboro.

NEW JERSEY.

Richard S. Jenkins	Camden.
William Wright	Newark.
F. M. Ward	Newton.

NEW YORK.

Hon. R. Barnwell Roosevelt, President	New York.
Gen. Richard U. Sherwood, Secretary	New Hartford.
Eugene G. Blackford	No. 70 Fulton Market, New York.
William H. Bowman	Rochester.

Superintendents.

Seth Green	Rochester.
Fred. Mather	Cold Spring Harbor.
Monroe A. Green	Mumford, Monroe County.
F. A. Walters	Bloomingdale, Essex County.
H. H. Thompson, Secretary	P. O. Box 25, New York City.

NORTH CAROLINA.

There is no Fish Commissioners in service in this State.

OHIO.

Col. L. A. Harris, President	Cincinnati.
Geo. Danials	Sandusky.
Henry Douglass, Superintendent	Sandusky.
James Dority	Toledo.

PENNSYLVANIA.

John Grey, President	Greenbury.
H. H. Derr, Secretary	Wilkesbarre.
Arthur Maginnis	Swift Water, Monroe Co.
A. M. Spangler	512 Commerce St., Philadelphia.
Aug. Duncan, Treasurer	Chambersburg.
Chas. Porter Corry	

RHODE ISLAND.

John H. Barden	Rockland.
Henry T. Root	Providence.
William P. Morton	Providence.

SOUTH CAROLINA.

Hon. A. P. Butler	Com. of Agriculture.

TENNESSEE.

W. W. McDowell	Memphis.
H. H. Sneed	Chattanooga.
Edward D. Hicks	Nashville.

VERMONT.

Hiram A. Cutting	Lunenburgh.
Herbert Brainard	St. Albans.

VIRGINIA.

Col. Marshall McDonald	Berryville.

WEST VIRGINIA.

C. S. White, President	Pomney.
W. A. Manning, Secretary	Tolcott.
F. J. Baxter, Treasurer	Baxton Court House.

WISCONSIN.

Philo Dunning, President	Madison.
C. L. Valentine, Secretary and Treasurer	Janesville.
J. U. Jones	Oshkosh.
A. U. H. Carpenter	Wilwaukee.
Mark Douglas	Melrose.
Calvert Spensley	Mineral Park.
James Nevin, Superintendent	Madison.

WASHINGTON TERRITORY.

Albert T. Stream	North Cove, Pacific County.

WYOMING TERRITORY.

Otto Gramm	Laramie.
Dr. W. H. Hemt, Commissioner for Laramie County	Cheyenne.
B. F. Northington, Commissioner for Carbon County	Rawlins.

DOMINION OF CANADA.

Hon. John Tilton, Deputy Minister of Fisheries	

PROVINCE OF NEW BRUNSWICK.

W. F. Venning, Inspector	St. John.

PROVINCE OF NOVA SCOTIA.

W. H. Rogers, Inspector	Amherst.

PROVINCE OF PRINCE EDWARD ISLAND.

J. H. Duvar, Inspector	Alberton.

PROVINCE OF QUEBEC.

W. Wakeham, Inspector	Lower St. Lawrence and Gulf Division.

PROVINCE OF BRITISH COLUMBIA.

Thomas Mowat, Acting Inspector	New Westminster.

PROVINCE OF MANITOBA AND NORTHWESTERN TERRITORY.

Alexander McQueen, Inspector	Winnipeg, Manitoba.
S. Wilmot, Superintendent of Fish Culture	Newcastle, Ontario.

Fish & Game Commission
Library Copy
SAN FRANCISCO, CALIF.

BIENNIAL REPORT

OF THE

ATE BOARD OF FISH COMMISSIONERS

OF THE

STATE OF CALIFORNIA,

FOR THE

YEARS 1886–1888.

COMMISSIONERS.

JOSEPH ROUTIER, Sacramento, President.
J. DOWNEY HARVEY, Los Angeles, Secretary.
CHARLES JOSSELYN, San Francisco.

SACRAMENTO:
STATE OFFICE : : : J. D. YOUNG, SUPT. STATE PRINTING.
1888.

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SACRAMENTO:
STATE OFFICE, : : : : J. D. YOUNG, SUPT. STATE PRINTING.
1888.

REPORT.

Honorable R. W. Waterman, *Governor of the State of California:*

Sir: As required by law, the State Board of Fish Commissioners herewith present their report of the transactions and disbursements of the Commissioners during the thirty-eighth fiscal year, ending June 30, 1887, and the thirty-ninth fiscal year, ending June 30, 1888.

Governor Washington Bartlett, on March 12, 1887, appointed Joseph Routier a member of the Board to succeed R. H. Buckingham, term expired, and J. Downey Harvey to succeed A. B. Dibble, term expired, both of whom were subsequently confirmed by the Senate. Messrs. Routier and Harvey, together with T. J. Sherwood, constituting the State Board of Fish Commissioners, organized on the twenty-fourth day of March, 1887, by electing Joseph Routier, President, and T. J. Sherwood, Secretary and Treasurer. The Board immediately entered upon a vigorous prosecution of the work of the Commission. The various subordinate officers, necessary to a discharge of the important duties of the Commission, were appointed, and the members of the Board looked forward to the accomplishment of many important results to the fishery interests of the State.

The work of the Commission was progressing very satisfactorily, until disturbed by the attempt on your part to reorganize the Commission by placing thereon persons of your own selection. This attempted removal of the members of the Commission (Routier and Harvey) discredited the acts of the Commission, destroyed public confidence in the legality of their official acts, and defeated all efforts to an efficient discharge of their duties. That the legal status of the Board might be determined, Mr. J. D. Redding, who had been appointed by you to succeed Commissioner Routier, obtained the permission of the Attorney-General to bring an action in the name of the people to oust Mr. Routier, but after suffering the action to remain in the Courts for several months, he caused it to be dismissed. Subsequently, the State Board of Examiners, moved by the clamor of claimants who had furnished supplies, or rendered services to the State, agreed that the question as to who were entitled to act as the State Board of Fish Commissioners should be submitted to the Attorney-General, and that the opinion of that officer should be binding upon the Board of Examiners until overruled by the Courts.

This course of the Board of Examiners was rendered necessary by the action of Messrs. Redding and Orr claiming under a commission issued by you, setting up a rival Board, and pretending to be the State Board of Fish Commissioners, and assuming to discharge the duties of such Commissioners. These gentlemen were subsequently reinforced by Mr. Charles Josselyn, appointed by you to succeed Commissioner T. J. Sherwood, resigned.

The Attorney-General in due time filed his opinion with the State Board of Examiners, affirming that the State Board of Fish Commissioners legally consisted of Messrs. Joseph Routier, J. Downey Harvey, and Charles Josselyn. Notwithstanding this opinion of the Attorney-General, and the previous agreement between the Board of Examiners and the rival Boards, Mr. Josselyn, as to whose right to the office no question existed, refused, and still refuses, to act with the majority of the Board.

These actions practically destroyed, for a time, the usefulness of the Board, and makes it impossible for us to lay before you any extended records of its labors. Discouraging as have been the obstructions thrown in our way, we have endeavored to protect and advance the interests of the State committed to our care, and believe that we have not been altogether unsuccessful in our efforts.

FISHING INTERESTS IN GENERAL.

The fishery interests of the State are in a comparatively satisfactory condition.

The salmon spring run of 1887 was quite small, as was also that of 1888. The fall run of 1887 did not show any improvement. The August run of this year was abundant. The supply of shad has been very large, and will increase materially each year. The supply of carp has been enormous, being found in all the rivers and waters of the State. The catch of sturgeon during the last and present year has been small. This must be attributed to the continued indiscriminate and criminal slaughter made by the Chinamen and other fishermen. Special efforts have been made to stock the rivers and lakes with the various species of trout. In these efforts we have been quite successful, as evidenced by the astonishment of many at finding them abundant in streams to which they had for years been strangers. Black bass have been distributed in different places throughout the State. The increase of this fish at Crystal Springs, San Mateo County, has been rapid, and is the source from which our supply has been obtained.

PATROL AND PROTECTION.

As in previous years, the patrol boat has been maintained upon the rivers and bays. That its work has been effective has been shown by the large number of arrests and convictions for violations of the fish laws of the State. The service, however expensive, is absolutely necessary to the protection of the fish interests of the State. The receipts into the State Treasury from fines for violations of fish laws amounted during the thirty-eighth fiscal year to $183 66, and for the thirty-ninth fiscal year to $1,751 98.

SEALS AND SEA LIONS.

We respectfully repeat the recommendations of the last report of the Fish Commissioners, as follows: These aquatic animals are a serious detriment to the fish interests of the State. They sit at the entrance of Golden Gate as royal toll gatherers, and take the lion's share of the schools of the finny tribe, as they pass from the broad Pacific into the bay of San Francisco, preparatory to an ascent of our rivers. In the opinion of the Commission, they are great destroyers of the salmon. They appear to be more numerous at Seal Rock, and around the entrance of San Francisco Bay, than in former years, owing, no doubt, to the fact that the fishermen have driven them with their nets from Suisun and San Pablo Bays. They not only guard the entrance of San Francisco Bay, but are found at the entrance of Monterey, Bolenas, Point Arena, Tomales, and Shoalwater Bays. This and former Commissions and the public press have repeatedly invoked legislative action to prevent the immense destruction of fish constantly going on and increasing by these worthless animals. It is highly important to our citizens to have the food of which they are so deprived, and in their behalf remedial legislation is again urgently demanded.

STEAM LAUNCH.

The steam launch "Governor Stoneman," constructed at a cost of over $4,000, has been found useless for the service for which it was intended. We have, in the interest of economy and an efficient service, laid it up, and used in its stead for patrol purposes a sloop rented and operated for a sum much less than the cost of running the launch. The main objection to the launch is that its approach can be discerned by those engaged in illegal fishing, at such distances as to enable them to escape detection in their criminal acts. We recommend that the "Governor Stoneman" be disposed of, as it is a bill of expense to the Commission.

SHEBLEY HATCHERY.

This hatchery was established in May, 1883. During that year there were hatched and distributed over ninety-five thousand trout. The output for 1887 was two million. During this year, up to the present time, fifty thousand. In addition to this trout hatchery, Captain Todman, with the authority of the Commission, established one at Lake Bigler, and hatched and released over five hundred thousand during the year 1887. The Commission this year rented the hatchery, and up to the present time have hatched and are distributing over six hundred thousand trout. The Commission contemplated the building of a trout hatchery at Donner Lake, but owing to the complications in which we found ourselves, were compelled to forego this intention. We believe that a hatchery should be constructed at that place, and so recommend.

STATE SALMON HATCHERY.

In March, 1885, the Legislature passed a bill, authorizing the Board of Fish Commissioners to erect and maintain a State Salmon Hatchery, and appropriated therefor the sum of $10,000. The site was selected and the hatchery erected during the term of office of our predecessors. The great expectations indulged in by the previous Commission have not been realized. An experience of two years has convinced us that the selection was an unfortunate one. During 1887 but two hundred thousand salmon were hatched. During the previous years, as I have been informed, a less number were hatched.

The location on Hat Creek is too high up in the river, and the salmon do not reach there until October, after the spawning season is over. Moreover, the climate is too severe, and the cost of maintaining the hatchery during the winter season too heavy. The distance of the hatchery from railroad communication—eighty miles—is another substantial objection to the site. We have abandoned its use and removed all the portable apparatus to Sisson, where a temporary hatchery has been established at a cost of $1,500.

The United States Fish Commission will furnish us all the eggs that we can handle. This will enable us to hatch and release about two million salmon during the present year.

DAMS AND FISH LADDERS.

Much has been accomplished towards securing observance of the law requiring the construction of fishways, so as to permit the free passage of fish. However, in a few instances, resistance has been made, and in one case, after the arrest and conviction of the offending parties, in the Justice's Court, an appeal was taken to the Superior Court, where it now rests.

APPROPRIATIONS AND EXPENSES.

The Legislature, at its last session, appropriated for the use of the Commission during the thirty-ninth fiscal year the sum of $7,500; and for the fortieth fiscal year the sum of $7,500. These appropriations, with the moneys received from licenses and fines, have been sufficient for the work of the Commission.

A detailed statement of the disbursements is herewith transmitted. Also a statement of moneys disbursed on account of certain deficiency claims allowed by the Legislature.

FISHERMEN'S LICENSES.

Under an Act of the Legislature, approved March 21, 1887, all persons engaged in the vocation of fishing were required to take out a license. The licenses and classes were arranged as follows: Class A (less than three men using one boat), $5 00; Class B (three men), $7 50; and for each additional man, $2 50. The receipts from licenses for the thirty-eighth fiscal year amounted to $2,100; and for the thirty-ninth fiscal year, $2,708 70.

We have met with many difficulties in our efforts to enforce this license tax. The fact that no penalty is provided by the Act for failing to take out the required license, has led to the release of some offenders by Justices of the Peace, who held that no punishment could be inflicted upon those who refuse or neglect to obey the law. This, in spite of the fact that a penalty is provided by Section 435 of the Penal Code. The number of licenses of the different classes sold, and the receipts therefrom during the year 1887, were as follows:

Class.	Number Sold.	Amounts Received.
A	651	$3,255 00
B	17	127 50
C	33	330 00
D	45	562 50
E	2	30 00
	748	$4,305 00

Of this amount—$4,305—the sum of $492 30 was deducted as commissions allowed by law for the collection of the licenses, leaving $3,812 70 as the net amount paid into the State Treasury from this source during the year stated. The receipts for the present year will be considerably less, owing partly to the disorganized condition of the Commission during the early part of the fishing season. Also the action of certain of the Courts, as detailed above.

LAWS RECOMMENDED.

The following recommendations of our predecessors in office, contained in their last report, are renewed: "The close season for salmon should be enlarged. It is now between the thirtieth day of August and the first day of October. It should be from the first day of August to the first day of October. The Commission earnestly recommends legislative remedial action to prevent the destruction of fish by seals and sea lions." We further recommend, for the reasons stated in another portion of this report, that the License Act be amended so as to declare the penalty for its violation. We also recommend that a law be passed providing for the confiscation and destruction of all unlawful nets or seines taken with persons arrested for illegal fishing. The possession of fish out of season, or fish of under size, should be made a misdemeanor. Some legislation should be had regarding the taking of immature fish, and defining "immature fish," at least so far as it concerns salmon, shad, sturgeon, and trout.

Respectfully submitted.

JOSEPH ROUTIER, President.
J. DOWNEY HARVEY, Secretary.

October 1, 1888.

EXPENDITURES

During the Thirty-eighth Fiscal Year, ending June 30, 1887, chargeable against the Appropriation for the Restoration and Preservation of Fish within the waters of the State.

To appropriation (General Appropriation Bill, Statutes of California, 1885, page 85)			$5,000 00
To additional appropriation, March 15, 1887 (Statutes, 1887, page 156)			405 18
By Expenditures.			
Warrant No. 558—To J. Shebley, salary and expenses, July 1 to 16, 1886	$83 35		
To William Shebley, labor and expenses	59 05	$142 40	
Warrant No. 2682—To A. B. Dibble, traveling and other expenses	$93 00		
To R. H. Buckingham, traveling and other expenses	45 15		
To Murcken & Knoch, supplies	7 47		
To J. H. Hartin, salary and expenses of Chief of Patrol	160 70		
To John Cropper, salary, watchman "Governor Stoneman"	30 00		
To Dennis & Fitzwater, supplies	32 38		
To Caledonian Insurance Co., insurance on hatchery at Hat Creek	96 00		
To Huntington, Hopkins & Co., supplies	12 56		
To payroll, July, 1886	120 00	597 26	
Warrant No. 3952—To A. B. Dibble, traveling and other expenses	$104 00		
To Goodall, Perkins & Co., 500 gallons of water	2 50		
To R. H. Buckingham, traveling and other expenses	73 35		
To Sullivan & Co., supplies	29 75		
To Murcken & Knoch, supplies	17 36		
To J. Shebley, salary and expenses	224 50		
To J. H. Hartin, salary and expenses, Chief of Patrol	296 00		
To Charles J. Hendery, supplies	13 00		
To W. T. Garratt, repairs for "Governor Stoneman"	5 50		
To payroll, August, 1886	263 34	1,029 30	
Warrant No. 4356—To S. P. Maslin, salary of Assistant Secretary and Treasurer, months of July, August, and September, 1886		90 00	
Warrant No. 4366—To Dennis & Fitzwater, supplies	$52 72		
To A. B. Dibble, traveling and other expenses	76 00		
To J. McArthur, supplies	8 66		
To Florin Bros., supplies	12 00		
To Burns & Kneass, supplies	103 50		
To I. N. Gill, supplies	10 25		
To Murcken & Knoch, supplies	36 10		
To payroll	238 50	537 73	
Warrant No. 4710—To R. H. Buckingham, traveling and other expenses	$179 80		
To Dennis & Fitzwater, supplies	22 88		
To Marysville Coal Gas Co., 1 barrel coal tar	6 00		
To J. H. Hartin, supplies and repairs, "Governor Stoneman"	138 50		
To J. H. Hartin, salary and expenses, Chief of Patrol, September, 1886	346 50	693 68	
Amount carried forward		$3,090 37	$5,405 18

EXPENDITURES—Continued.

Amount brought forward		$3,090 37	$5,405 18
Warrant No. 5429—To A. B. Dibble, traveling and other expenses	$80 00		
To Bidwell Bros., supplies	17 60		
To R. H. Buckingham, traveling and other expenses	94 20		
To Fall River Mills, supplies	19 77		
To J. Shebley, labor and expenses, October, 1886	147 45		
To Murcken & Knoch, supplies	22 16		
To payroll, October, 1886	229 00		
		610 18	
Warrant No. 5430—To S. P. Maslin, salary, October, 1886		30 00	
Warrant No. 6543—To S. P. Maslin, salary as Assistant Secretary, November, 1886		30 00	
Warrant No. 6544—To J. H. Miller, clerical services		25 00	
Warrant No. 6828—To S. P. Maslin, salary as Assistant Secretary, December, 1886		30 00	
Warrant No. 6829—To R. H. Buckingham, traveling and other expenses	$46 00		
To A. B. Dibble, traveling and other expenses	83 00		
To J. McArthur, supplies	5 00		
To W. J. McDowell, supplies	31 00		
To W. H. Schnittger, wood and hauling	22 00		
To H. Buckingham, watchman "Governor Stoneman," November, 1886	30 00		
To Murcken & Knoch, supplies	41 76		
To Dennis & Fitzwater, supplies	80 60		
To payroll November, 1886	241 50		
		580 86	
Warrant No. 7347—To T. J. Sherwood, traveling and other expenses	$62 40		
To T. J. Sherwood, traveling and other expenses	52 90		
To A. B. Dibble, traveling and other expenses	96 25		
To H. Buckingham, watchman "Governor Stoneman," December, 1886	30 00		
To C. W. Pierce	4 65		
To Murcken & Knoch	26 57		
To payroll December, 1886	187 75		
		460 52	
Warrant No. 7453—To Black Diamond Coal Mining Company, coal		95 80	
Warrant No. 8956—To H. Woodson, 70,000 trout eggs	$100 00		
To A. B. Dibble, traveling and other expenses	96 25		
To Murcken & Knoch, supplies	6 15		
To payroll January 1 to 15, 1887	153 20		
	$355 60		
Less deficiency in appropriation	308 33		
		47 27	
Warrant No. 13163—To J. H. Hartin, salary and expenses Chief of Patrol, December, 1886	$65 00		
To H. F. Johnson, supplies	3 85		
To Dennis & Fitzwater, supplies	28 00		
		96 85	
Warrant No. 13164—To balance due on deficiency claims shown in Warrant No. 8956		308 33	
			$5,405 18

EXPENDITURES

During the Thirty-ninth Fiscal Year, ending June 30, 1888, chargeable against the Appropriation for the Restoration and Preservation of Fish in the waters of the State.

To appropriation (Statutes of California, 1887, page 215)			$3,750 00
By Expenditures.			
Warrant No. 1498—To J. W. Willage, services as Chief of Patrol, July, 1887	$33 33		
To J. W. Willage, provisions, etc.	61 30		
To J. W. Willage, rent and repairs to sloop	124 90		
To J. W. Willage, expenses and board	24 75		
To John S. Benn, boat hire, etc.	85 60		
To Catania & Carlett, boat hire, etc.	59 00		
To W. S. Shebley, labor at hatchery	74 00		
To Frank Sherwood, cook on boat	33 00		
To William Haven, cook on boat	5 50		
To Walter Markham, deckhand	34 00		
To W. E. Elliott, Captain of boat	60 00		
To Orson Elliott, watchman on boat	16 66		
To John Howard, deckhand	16 66		
To John Richardson, pilot	22 50		
To John F. Moody, removing obstructions	20 00		
To T. J. Sherwood, expenses as Commissioner	102 05		
To J. Routier, expenses as Commissioner	51 90		
To J. Downey Harvey, expenses as Commissioner	46 00		
To Le Count Bros., lithographing	40 00		
To Black Diamond Coal Company, coal	95 85		
		$1,007 00	
Warrant No. 1955—To J. W. Willage, rent of sloop, July, 1887	$60 00		
To J. W. Willage, traveling expenses	23 50		
To J. W. Willage, traveling expenses	11 00		
To Walter Markham, cook on boat	40 00		
To Orson Elliott, deckhand	50 00		
To John Howard, mate	50 00		
To W. E. Elliott, pilot	60 00		
To J. W. Willage, services as Chief of Patrol	100 00		
To J. W. Willage, expenses in trials	10 00		
To J. W. Willage, provisions, etc.	79 10		
To J. W. Willage, rent and expenses of sloop	50 00		
		533 60	
Warrant No. 4222—To J. W. Willage, salary and expenses	$283 50		
Warrant No. 4223—To J. W. Willage, rent of sloop	60 00		
Warrant No. 4224—T. J. Sherwood, expenses as Commissioner	76 70		
Warrant No. 4225—To J. Routier, expenses as Commissioner	75 80		
Warrant No. 4226—To Marysville "Appeal," printing	50 00		
		501 00	
Warrant No. 4945—To Orson Elliott, labor on patrol boat	$50 00		
Warrant No. 4946—To Walter Markham, labor on patrol boat	50 00		
Warrant No. 4947—To John Howard, labor on patrol boat	50 00		
Warrant No. 4948—To W. E. Elliott, labor on patrol boat	60 00		
Warrant No. 4949—To J. W. Willage, salary, expenses, and supplies	191 75		
Warrant No. 4950—To T. J. Sherwood, expenses as Commissioner	104 50		
Warrant No. 4951—To J. Routier, expenses as Commissioner	89 50		
Warrant No. 4952—To J. F. Cunningham, supplies	34 97		
		630 72	
Warrant No. 7285—To J. W. Willage, salary and expenses	$173 50		
Warrant No. 7286—To John F. Moody, expenses serving papers	7 50		
Warrant No. 7287—To J. Routier, expenses as Commissioner	35 80		
Amount carried forward		$2,673 12	$3,750 00

EXPENDITURES—Continued.

Amount brought forward		$2,673 12	$3,750 00
Warrant No. 7288—To J. Downey Harvey, expenses as Commissioner	$44 00		
Warrant No. 7289—To T. J. Sherwood, expenses as Commissioner	107 20		
Warrant No. 7290—To Westgate, Ruble & Co., supplies for sloop	54 40		
		422 40	
Warrant No. 10049—To Mrs. J. W. Willage, expenses of J. W. Willage, deceased		88 90	
Warrant No. 12546—To Mrs. J. W. Willage, labor and supplies furnished by J. W. Willage, deceased		16 00	
Warrant No. 12547—To J. Downey Harvey, expenses as Commissioner		83 00	
Warrant No. 12548—To J. Routier, expenses as Commissioner		162 45	
Balance on hand July 1, 1888		304 93	
			$3,750 00

EXPENDITURES

During the Thirty-ninth Fiscal Year, ending June 30, 1888, chargeable against the Appropriation for the Support and Maintenance of State Hatcheries.

By appropriation (Statutes of California, page 215)		$3,750 00
By Expenditures.		
Warrant No. 1954—To J. Shebley, salary and expenses at hatchery	$309 75	
Warrant No. 4953—To J. Shebley, salary and expenses at hatchery	168 54	
Warrant No. 4954—To E. W. Hunt, salary at hatchery	60 00	
Warrant No. 4955—To Frank Sherwood, salary at hatchery	50 00	
Warrant No. 4956—To Murcken & Knoch, supplies	16 21	
Warrant No. 4213—To W. H. Shebley, distributing fish	158 10	
Warrant No. 4214—To J. Shebley, distributing fish, and salary, etc.	187 19	
Warrant No. 4215—To E. C. Ross & Co., pipe, etc.	58 60	
Warrant No. 4216—To E. W. Hunt, labor	57 30	
Warrant No. 4217—To W. F. Sherwood, cook	36 70	
Warrant No. 4218—To Murcken & Knoch, repairs	50 00	
Warrant No. 4219—To E. B. Bainbridge. groceries	40 91	
Warrant No. 4220—To M. Kerney, meats	11 75	
Warrant No. 4221—To T. J. Sherwood, traveling expenses	76 70	
Warrant No. 7291—To E. B. Bainbridge, supplies	64 38	
Warrant No. 7292—To M. Kerney, meats	6 40	
Warrant No. 7293—To William Schnittger, teaming	11 50	
Warrant No. 7294—To Frank Sherwood, cook	50 09	
Warrant No. 7295—To E. W. Hunt, labor	60 00	
Warrant No. 7296—To J. Shebley, salary as Supt., and supplies	126 85	
Warrant No. 7297—To J. S. Benn, fish and expenses	164 70	
Warrant No. 7298—To W. H. Shebley, salary and expenses as Supt., distributing fish	433 85	
Warrant No. 9380—To E. B. Bainbridge, supplies	35 94	
Warrant No. 9381—To E. W. Hunt, labor	50 00	
Warrant No. 9382—To W. F. Sherwood, cook	40 00	
Warrant No. 9383—To Murcken & Knoch. supplies	5 85	
Warrant No. 9384—To W. H. Shebley, salary as Supt., and expenses	71 60	
Warrant No. 11592—To W. H. Schnittger, supplies	27 00	
Warrant No. 11593—To W. F. Sherwood, cook	40 00	
Warrant No. 11594—To E. W. Hunt, labor	50 00	
Warrant No. 11595—To Murcken & Knoch, supplies	8 25	
Warrant No. 11596—To E. B. Bainbridge, supplies	26 05	
Warrant No. 11597—To W. H. Shebley, supplies, etc.	85 85	
Warrant No. 11598—To J. Shebley, services and expenses	52 08	
Warrant No. 11599—To E. B. Bainbridge, supplies	13 70	
Warrant No. 12564—To W. H. Shebley, salary and expenses as Supt.	68 15	
Warrant No. 12565—To E. W. Hunt, salary and expenses	56 21	
Warrant No. 12568—To E. B. Bainbridge, supplies	22 88	
Warrant No. 12569—To Murcken & Knoch, supplies	5 08	
Warrant No. 12570—To W. F. Sherwood, cook	40 00	
Balance on hand July 1, 1888	851 93	
		$3,750 00

EXPENDITURES

During the Thirty-eighth Fiscal Year, ending June 30, 1887, chargeable against the Fish Commission Fund.

By receipts into the fund, thirty-eighth fiscal year			$2,283 66
By Expenditures.			
Warrant No. 14887—To Le Count Bros., record and account books	$6 00		
To C. H. Evans, repairs to steamer "Governor Stoneman"	41 96		
To Charles J. Hendery, supplies for steamer	5 60		
To Charles J. Hendery, supplies for steamer	9 00		
To Orson Elliott, labor on steamer	23 50		
To John Howard, labor on steamer	23 50		
To William Havens, labor on steamer	18 00		
To John Richardson, pilot	37 50		
To Alexander Harper, labor on steamer	31 25		
To J. W. Willage, expenses moving "Governor Stoneman"	53 30		
To J. W. Willage, provisions, etc., for steamer	23 70		
To J. W. Willage, salary as Chief of Patrol	70 00		
To Pacific Printing House, printing license blanks	30 00		
To H. Buckingham, watchman steamer "Governor Stoneman"	20 00		
To J. Routier, expenses as Commissioner	135 20		
To T. J. Sherwood, expenses as Commissioner	84 50		
		$613 01	
Warrant No. 15683—To G. A. Gillespie, fees in cases of illegal fishing		12 00	
Warrant No. 15684—To Jim Chin, services as interpreter in cases of illegal fishing		6 00	
Warrant No. 15826—To J. W. Kerns, stove, etc., for steamer "Governor Stoneman"	$16 75		
To J. S. Benn, rent of plunger, etc.	10 00		
To T. W. O'Neil, tin tags for licenses	546 00		
To J. W. Willage, expenses as Chief of Patrol	49 88		
To J. W. Willage, supplies for steamer	34 75		
To Westgate, Ruble & Co., supplies for steamer	65 87		
To John Howard, deckhand	50 00		
To Orson Elliott, watchman on steamer	50 00		
To William Havens, cook on steamer	40 00		
To C. A. Sweeney, expenses in cases of illegal fishing	14 85		
To D. D. Willis, expenses in cases of illegal fishing	9 00		
To J. R. Lewis, expenses attending meeting of the Board as License Collector	20 00		
To J. W. Willage, salary as Chief of Patrol	100 00		
To John Richardson, salary as pilot	75 00		
To A. Harper, salary as engineer of steamer "Governor Stoneman"	75 00		
To Charles Chinn, services as interpreter in trials for illegal fishing	3 00		
To G. H. Kinloch, Constable fees in cases of illegal fishing	13 20		
To J. Downey Harvey, expenses as Commissioner	140 00		
To Joseph Routier, expenses as Commissioner	121 85		
Amount carried forward		$631 01	$2,283 66

EXPENDITURES—Continued.

Amount brought forward		$631 01	$2,283 66
To T. J. Sherwood, expenses as Commissioner	101 15		
To J. R. Lewis, expressage, etc., for License Collector	5 90		
		1,546 20	
Balance on hand July 1, 1887		106 45	
			$2,283 66

EXPENDITURES.

During the Thirty-ninth Fiscal Year, ending June 30, 1888, chargeable against the Fish Commission Fund.

By balance on hand July 1, 1887			$106 45
Receipts into the fund, thirty-ninth fiscal year			4,460 68
By Expenditures.			
Warrant No. 1500—To R. C. Carter, stovepipe	$2 00		
To A. Harper, engineer on steamer	15 00		
To S. T. Hadley, blacksmithing	5 00		
To J. W. Willage, traveling expenses	21 00		
To J. W. Willage, block and tackle	1 75		
To J. W. Willage, traveling expenses	36 00		
To J. W. Willage, provisions, etc.	29 60		
To J. W. Willage, rent of sloop	50 00		
To Orson Elliott, services as watchman on steamer	41 69		
To Frank Sherwood, services as cook	31 51		
To John Howard, services as deckhand	41 69		
To John Richardson, services as pilot	62 50		
To J. S. Benn, seven days labor	21 00		
To Le Count Bros., stationery	11 25		
To J. S. Benn, fish net, tank, etc.	41 45		
To J. Routier, expenses, etc., as Commissioner	132 50		
To T. J. Sherwood, expenses, etc., as Commissioner	157 20		
To J. W. Willage, services as Chief of Patrol	83 35		
		$784 49	
Warrant No. 4535—To J. Shebley, labor and expenses		236 62	
Warrant No. 4536—To John Koon, expenses in arrests for illegal fishing	$14 50		
Warrant No. 4537—To J. W. Willage, services as Chief of Patrol	66 67		
Warrant No. 4538—To John Howard, services as deckhand	33 34		
Warrant No. 4539—To Orson Elliott, services as watchman on steamer	33 34		
Warrant No. 4540—To J. Routier, expenses, etc., as Commissioner	162 05		
Warrant No. 4541—To T. J. Sherwood, expenses, etc., as Commissioner	87 40		
Warrant No. 4542—To T. J. Sherwood, expenses, etc., as Commissioner	65 00		
Warrant No. 4543—To A. B. Dibble, expenses and printing, suit of People vs. Dobbins	32 75		
Warrant No. 4544—To J. Downey Harvey, expenses, etc., as Commissioner	20 00		
Warrant No. 4545—To John Koon, expenses in arrests for illegal fishing	6 00		
		521 05	
Warrant No. 4943—To J. Routier, per diem as Commissioner	$65 00		
Warrant No. 4944—To T. J. Sherwood, per diem as Commissioner	70 00		
		135 00	
Amount carried forward		$1,677 16	$4,567 13

Expenditures—Continued.

Amount brought forward		$1,677 16	$4,567 13
Warrant No. 5909—To J. Routier, per diem as Commissioner	$75 00		
Warrant No. 5910—To T. J. Sherwood, per diem as Commissioner	90 00		
		165 00	
Warrant No. 7281—To T. J. Sherwood, per diem as Commissioner	$55 00		
Warrant No. 7282—To J. Routier, per diem as Commissioner	35 00		
Warrant No. 7283—To J. Downey Harvey, per diem as Commissioner	15 00		
Warrant No. 7284—To Westgate, Dozier & Co., supplies	23 35		
		128 35	
Warrant No. 9385—To J. Downey Harvey, expenses, etc., as Commissioner		74 00	
Warrant No. 9386—To T. J. Sherwood, expenses, etc., as Commissioner		73 90	
Warrant No. 10031—To J. Routier, expenses, etc., as Commissioner		30 20	
Warrant No. 11587—To Murcker & Knoch, supplies for hatchery at Hat Creek		5 15	
Warrant No. 11588—To W. F. Sherwood, labor, etc., for hatchery at Hat Creek		24 55	
Warrant No. 11589—To W. H. Shebley, salary and expenses as Superintendent of Hatchery		66 25	
Warrant No. 11590—To W. F. Sherwood, services as cook at hatchery		40 00	
Warrant No. 11591—To W. H. Schnittger, services as watchman, etc., at hatchery		24 50	
Warrant No. 12571—To L. Meyer & Co., supplies to Chief of Patrol		4 25	
Balance on hand July 1, 1888		2,253 82	
			$4,567 13

DEFICIENCIES

Incurred during the Thirty-fifth Fiscal Year, ending June 30, 1884, and during the Thirty-seventh Fiscal Year, ending June 30, 1886, chargeable against the Appropriation for the Restoration and Preservation of Fish within the waters of the State.

Appropriation to provide for the deficiency for the thirty-fifth fiscal year		$19 65
Warrant No. 13160—To balance due on claims contained in vouchers on which warrant No. ——,—— fiscal year, was issued	$19 65	
Appropriation to provide for the deficiency for the thirty-eighth fiscal year		869 20
Warrant No. 13161—To balance due on claims contained in vouchers on which warrant No. 6442, thirty-seventh fiscal year, was issued	39 10	
Warrant No. 13162—To R. H. Buckingham	82 00	
To A. B. Dibble	288 94	
To J. Shebley	86 66	
To W. C. Jones	80 00	
To J. H. Hartin	137 00	
Payroll	157 50	
	$869 20	

DEFICIENCIES

Incurred during the Thirty-seventh Fiscal Year, ending June 30, 1886, chargeable against the Appropriation for Support and Maintenance of a State Salmon Hatchery.

Appropriation		$895 47
Warrant No. 13165—To Dennis & Fitzwater, supplies for hatchery	$47 60	
Warrant No. 13166—To Dennis & Fitzwater, supplies for hatchery	92 94	
To H. Schnittger, supplies for hatchery	9 55	
To Murcken & Knoch, supplies for hatchery	23 35	
To Florin Bros.	20 46	
To S. P. Maslin, services as Assistant Secretary	60 00	
Payrolls, April, May, and June, 1886	450 00	
Warrant No. 13167—To Dennis & Fitzwater, supplies to hatchery	30 20	
To Murcken & Knoch, supplies to hatchery	11 37	
Payroll, April	150 00	
	$895 47	

BIENNIAL REPORT

OF THE

STATE BOARD OF FISH COMMISSIONERS

OF THE

STATE OF CALIFORNIA,

FOR THE

YEARS 1888–1890.

COMMISSIONERS.

JOSEPH ROUTIER, Sacramento, President.
J. DOWNEY HARVEY, San Francisco, Secretary.
CHARLES JOSSELYN, San Francisco.

SACRAMENTO:
STATE OFFICE, : : : : : : : J. D. YOUNG, SUPT. STATE PRINTING.
1890.

REPORT.

To Hon. R. W. Waterman, *Governor of the State of California:*

Sir: The undersigned have the honor hereby to present their Second Biennial Report relative to the fish industry of the State.

The fish interests of the State are in a comparatively satisfactory condition.

The spring run of salmon for 1889 was fair, as was also that of 1890. The fall run of 1889 showed improvement over that of the previous years. The supply of shad continues to be large. Carp is found in large quantities in all the waters of the State; they are not a desirable food fish. Sturgeon continues to diminish every year, owing to the indiscriminate slaughter waged upon them by Chinese fishermen. Special efforts have been made to stock the rivers and lakes with the various species of trout. In these efforts we have been quite successful, as evidenced by the astonishment of many at finding them abundant in streams to which they had for years been strangers. This will appear more pointedly in the report of the Superintendent of Hatcheries. Black bass have been distributed in different places throughout the State. The increase of this fish at Crystal Springs, San Mateo County, has been rapid, and is the source from which our supply has been obtained. Catfish have developed into popular favor, and are plentiful in most of the waters of the State.

SEALS AND SEA LIONS.

We respectfully repeat the recommendations of the last report of the Fish Commissioners, as follows: These aquatic animals are a serious detriment to the fish interests of the State. They sit at the entrance of Golden Gate as royal toll gatherers, and take the lion's share of the schools of the finny tribe as they pass from the broad Pacific into the bay of San Francisco, preparatory to an ascent of our rivers. In the opinion of the Commission, they are great destroyers of the salmon. They appear to be more numerous at Seal Rock and around the entrance of San Francisco Bay than in former years, owing, no doubt, to the fact that the fishermen have driven them with their nets from Suisun and San Pablo Bays. They not only guard the entrance of San Francisco Bay, but are found at the entrance of Monterey, Bolenas, Point Arena, Tomales, and Shoalwater Bays. This and former Commissions and the public press have repeatedly invoked legislative action to prevent the immense destruction of fish constantly going on and increasing by these worthless animals. It is highly important to our citizens to have the food of which they are so deprived, and in their behalf remedial legislation is again urgently demanded.

STEAM LAUNCH.

The steam launch "Governor Stoneman," constructed at a cost of over $4,000, was found useless for the service for which it was intended.

In the interest of economy and an efficient service, and in response to an Act of the Legislature, we disposed of it for the sum of $1,100, which money is in the State Treasury for the purchase of other boats suited to economical use in quest of persons engaged in illegal fishing.

HATCHERIES.

The Shebley Hatchery has been abandoned, the supply of water being inadequate. The Hat Creek Hatchery has been abandoned, and it is the desire of the Commission that the Legislature provide for its removal to a more desirable location. The Sisson Hatchery has been a great success. A new hatchery has also been constructed at Lake Tahoe. The details relating to all these hatcheries, will be found in the report of the Superintendent of Hatcheries. The United States Fish Commission have furnished us with all the eyed salmon eggs it is possible for us to handle, for which they are entitled to the thanks of every person in the State.

FISH LADDERS.

Fish ladders have been built in most places where necessary, but many are not properly built, are not kept in repair, and are to a considerable extent inefficient, owing to the fact that the Board has no appropriation from which to defray the expenses of construction.

The last Legislature appropriated $500 for the removal of obstructions at Salmon Falls, in the American River. This has been successfully accomplished.

LICENSES.

The amount received from sales of licenses to fishermen for last year exceeds the sum received for sales of the previous year. The receipts were as follows:

Licenses for the Year 1888.

Received of Controller.	Class.	Value of Each.	On Hand March 31, 1889.	Sold during the Year.	Total Value of Licenses Sold.	Commissions Allowed for Collecting.	Net Amount due the State.
700	A	$5 00	208	492	$2,485 00	$300 01	$2,184 99
100	B	7 50	93	7	52 50	7 87	44 63
100	C	10 00	83	17	170 00	25 50	144 50
100	D	12 50	77	23	287 50	43 12	244 38
5	E	15 00	4	1	15 00	2 25	12 75
Total, 1,005	------	----------	465	540	$3,010 00	$378 75	$2,631 25

Licenses for the Year 1889.

Received of Controller.	Class.	Value of Each.	On Hand March 31, 1890.	Sold during the Year.	Total Value of Licenses Sold.	Commissions Allowed for Collecting.	Net Amount due the State.
775	A	$5 00	19	756	$3,780 00	$356 25	$3,423 75
50	B	7 50	35	15	112 50	16 87	95 63
50	C	10 00	28	22	220 00	31 50	188 50
52	D	12 50	26	26	325 00	48 75	276 25
1	E	15 00	----------	1	15 00	2 25	12 75
Total, 928	------	----------	108	820	$4,452 50	$455 62	$3,996 88

APPROPRIATIONS.

The last Legislature appropriated $20,000, one half of which was to be used for support in each of the forty-first and forty-second fiscal years. The expenditures made will be found in the proper place herein. The sum of $2,000 was appropriated for the purchase and importation of certain game birds into the State. The Board has so far been unable to obtain most of the species named in the Act, but hopes yet to secure them. Some quantities of Chinese quail and Oregon pheasants have been purchased and distributed in accessible localities. These quail have propagated already fairly well, and supplies can soon be had from them for other localities, as required. The $2,000 appropriated for the prosecution of violators of the fish laws has been expended, and was insufficient to defray the costs of prosecutions.

The Oregon pheasants can only be had by sending agents there to buy them in person, and they cannot be had at less than about $15 per pair. So far only forty pairs have been secured. The cost of the Chinese quail is about $20 per hundred. We have obtained about one thousand three hundred so far. These have been distributed pretty widely throughout the State. The amount so far drawn from the appropriations for game birds is $1,500, of which up to this time the sum of $1,020 has been expended.

COUNTY GOVERNMENT BILL.

Section 38 of the Act of March 16, 1889, amending the County Government Act, authorizing the Boards of Supervisors to fix the size of fish net meshes, should be repealed. If one county has one law, and another county another one, it renders it impossible for violators of the law to be punished, and the law thereby becomes inoperative. One county has already fixed the size of meshes for fishing at four inches, instead of the seven and one half inches prescribed by the statutes.

If the Legislature should agree with the recommendations of the Superintendent of Hatcheries for the creation of more hatcheries, the appropriation he asks for, or more, may be necessary. We recommend an appropriation of $10,000 for patrol purposes. If illegal fishing is to be prohibited, men enough to patrol the rivers must be had; otherwise, illegal fishing will go on as usual with impunity.

FOOD FISHES.

In its proper place herein will be found an interesting and instructive paper on the food fishes of this State from the pen of Dr. C. H. Eigenmann, who is regarded as authority upon that subject; also, a letter from Dr. H. W. Harkness, President of the California Academy of Sciences.

WIRE SCREENS FOR IRRIGATION DITCHES.

The millions upon millions of fish, large and small, that pass into the open heads of irrigating ditches, only to die when the water becomes exhausted, will decimate the fish supply faster than it can be restored from all the hatcheries in the State, in those localities where irrigation is largely in use. This has rendered necessary in some of the States the enactment of laws requiring the use of close-meshed wire screens at the entrance to all irrigating ditches in the State. What is necessary elsewhere, is indispensable here, and we recommend the passage of a law here similar to the following law in the State of Wyoming upon this subject:

> Any person or persons, corporation or corporations owning in whole or in part, or leasing, operating, or having in charge any mill-race, irrigating ditch, or canal, taking or receiving its water from any river, creek, or stream in this territory in which fish has been placed or may exist, shall put or cause to be placed and maintained over the inlet of such ditch, canal, or mill-race a wire screen of such construction, fineness, strength, or quality as shall prevent any such fish from entering such ditch, canal, or mill race, when requested to do so by the Fish Commissioner.
>
> Any person or persons, corporation or corporations violating the provisions of the preceding section, or who shall neglect or refuse to provide, put up, and maintain such screen, in accordance with the provisions of the preceding section, shall be guilty of a misdemeanor, and on conviction thereof shall be punished by a fine of not less than ten dollars, and not more than one hundred dollars, or by imprisonment in the county jail not exceeding thirty days for each offense; *provided*, that the continuance by any person of such neglect or refusal from day to day after notification in writing shall constitute a separate and distinct offense for each and every day of the continuance of such neglect or refusal; *provided further*, that no offense shall be committed by reason of such screens not over the inlet of any ditch, canal, or mill-race when water is not entering the same.

LAWS RECOMMENDED.

We desire to renew the recommendations contained in our last biennial report, to wit:

"The close season for salmon should be enlarged. It is now between the thirtieth day of August and the first day of October. It should be from the first day of August to the first day of October. The Commission earnestly recommends legislative remedial action to prevent the destruction of fish by seals and sea lions. We further recommend that the License Act be amended so as to declare the penalty for its violation. We also recommend that a law be passed providing for the confiscation and destruction of all unlawful nets, seines, and traps of any description found in use. The possession of fish out of season, or fish of under size, should be made a misdemeanor. Some legislation should be had regarding the taking of immature fish, and defining 'immature fish,' at least so far as it concerns salmon, shad, sturgeon, and trout."

DEER.

We recommend that the killing of deer be prohibited absolutely for the next two years, and also the having in possession the skin of any deer for the same time. This is rendered necessary because of the great loss of these animals during the extremely severe weather of the last two winters, as well as their indiscriminate slaughter in some localities by hunters who defy the law with impunity. With these men, nothing save the heavy hand of the law can be made effective.

JOSEPH ROUTIER,
J. DOWNEY HARVEY,
Fish Commissioners.

EXPENDITURES

During the Fortieth Fiscal Year, ending June 30, 1889, chargeable against the Appropriation for the Restoration and Preservation of Fish in the waters of the State.

Balance on hand July 1, 1888		$304 93
Warrants issued during fortieth fiscal year for services performed during the thirty-ninth fiscal year:		
By Expenditures.		
Warrant No. 468—To O. P. Egbert, supplies	$13 55	
No. 469—To W. E. Elliott, salary	66 50	
No. 470—To John Howard, salary and expenses	56 50	
No. 471—To Goldberg, Bowen & Co., supplies	37 06	
		173 61
Balance on hand from thirty-ninth year		$131 32
By appropriation (Statutes of California, page 215)		3,750 00
By Expenditures.		
Warrant No. 2226—To J. P. Dalton, salary and expenses	$240 71	
No. 3085—To J. P. Dalton, salary and expenses	714 90	
No. 3086—To O. P. Egbert, supplies	39 15	
No. 3088—To Goldberg, Bowen & Co., supplies	12 38	
No. 3089—To J. G. Woodbury, salary and expenses	173 70	
No. 3090—To W. E. Elliott, salary	60 00	
No. 3091—To John Howard, salary	50 00	
No. 3092—To Charles Wenzinger, salary	50 00	
No. 5519—To John P. Dalton, salary and expenses	310 00	
No. 5561—To O. P. Egbert, supplies	14 30	
No. 5562—To Goldberg, Bowen & Co., supplies	15 52	
No. 6170—To John P. Dalton, salary and expenses	177 50	
No. 8271—To J. G. Woodbury, salary and expenses	156 96	
No. 12294—To John P. Dalton, salary and expenses	216 70	
No. 12295—To John P. Dalton, salary and expenses	159 85	
No. 12296—To John A. Richardson, salary	75 00	
No. 12297—To E. W. Hunt, salary	45 00	
No. 12298—To J. G. Woodbury, salary and expenses	241 83	
No. 12299—To J. G. Woodbury, salary and expenses	270 38	
No. 12300—To Osborn & Alexander, supplies	20 90	
No. 12301—To O. P. Egbert, supplies	7 15	
No. 12302—To W. H. Schnittger, salary	10 00	
No. 15455—To John P. Dalton, salary and expenses	208 00	
No. 15456—To John P. Dalton, salary and expenses	221 10	
No. 15777—To Osborn & Alexander, supplies	24 10	
No. 15778—To J. F. Curley, salary	25 00	
No. 16000—To Osborn & Alexander, supplies	21 45	
No. 16797—To R. Lauritzen, supplies	5 51	
No. 16798—To Osborn & Alexander, supplies	14 45	
No. 16799—To O. P. Egbert, supplies	25 15	
No. 16800—To Goldberg, Bowen & Co., supplies	32 15	
No. 17054—To James McKenna, salary	5 00	
No. 18249—To R. Lauritzen, supplies	11 30	
No. 18267—To Osborn & Alexander, supplies	14 10	
No. 18268—To Goldberg, Bowen & Co., supplies	24 60	
No. 18269—To O. P. Egbert, supplies	37 40	
No. 18270—To John P. Dalton, salary and expenses	126 55	
No. 1286—To O. P. Egbert, supplies (paid in 41st fiscal year)	23 53	
Totals	$3,881 32	$3,881 32

EXPENDITURES

During the Fortieth Fiscal Year, ending June 30, 1889, chargeable against the Appropriation for the Support and Maintenance of State Hatcheries.

Unexpended balance on hand July 1, 1888		$851 93
Warrants issued during the fortieth fiscal year, for services performed during the thirty-ninth fiscal year:		
Warrant No. 208—To J. Shebley, salary and expenses	$69 20	
No. 472—To W. H. Schnittger, salary and expenses	60 00	
No. 473—To Stevens & McKinny, supplies	200 00	
No. 1628—To J. C. Frazier, labor	93 34	
		422 54
Balance on hand from thirty-ninth year		$429 39
To appropriation (Statutes of California, 1887, page 215)		3,750 00
Warrant No. 1195—To Henry Woodson, supplies	$101 30	
No. 1197—To J. C. Frazier, salary	100 00	
No. 1196—To Stevens & McKinney, supplies	400 00	
No. 1629—To W. H. Shebley, expenses	63 35	
No. 1630—To J. Shebley, salary	93 00	
No. 3087—To W. H. Shebley, salary	81 30	
No. 3093—To John Hurley, rent	20 00	
No. 3094—To J. C. Frazier, salary	118 82	
No. 3095—To W. H. Schnittger, salary	60 00	
No. 5267—To J. G. Woodbury, salary and expenses	298 18	
No. 5533—To J. F. Wyman, supplies	8 12	
No. 5535—To J. C. Frazier, supplies	48 66	
No. 5534—To R. M. Watson, supplies	8 00	
No. 5558—To Sisson Lumber Company, supplies	364 71	
No. 5559—To Sisson, Crocker & Co., supplies	97 32	
No. 5560—To J. M. Bowles, Jr., supplies	42 50	
No. 6163—To J. G. Woodbury, salary and supplies	57 70	
No. 6164—To W. C. Gifford, labor	50 00	
No. 6165—To Whittier, Fuller & Co., supplies	13 00	
No. 6166—To J. H. Sisson, supplies	58 65	
No. 6167—To W. H. Schnittger, salary	5 00	
No. 6168—To Holbrook, Merrill & Stetson, supplies	17 51	
No. 6169—To Sisson Lumber Company, supplies	17 47	
No. 8895—To L. Stone, labor	375 00	
No. 8896—To Sisson, Crocker & Co., supplies	48 00	
No. 8897—To Fred. C. Boyce, labor	50 00	
No. 8898—To E. W. Hunt, salary	55 65	
No. 8899—To Mount Shasta Manufacturing Co., supplies	71 40	
No. 8900—To W. C. Gifford, labor	37 50	
No. 8901—To F. C. Boyce, labor	45 00	
No. 8902—To Robert Radcliff, freight	20 00	
No. 8903—To J. A. Richardson, traveling expenses	85 65	
No. 8904—To J. H. Sisson, supplies	41 30	
No. 8905—To J. C. Frazier, supplies	112 66	
No. 8906—To J. G. Woodbury, salary and supplies	169 41	
No. 12292—To Edson & Co., supplies	10 65	
No. 12293—To F. C. Boyce, labor	25 00	
No. 16783—To E. W. Hunt, labor	41 65	
No. 16784—To W. H. Schnittger, labor	10 00	
No. 17015—To J. G. Woodbury, salary and supplies	266 41	
No. 17053—To J. A. Richardson, salary and supplies	78 15	
No. 18250—To J. G. Woodbury, salary and supplies	465 33	
No. 18251—To W. H. Schnittger, salary and supplies	10 00	
Balance on hand July 1, 1889	36 04	
Totals	$4,179 39	$4,179 39

EXPENDITURES

During the Fortieth Fiscal Year, ending June 30, 1889, chargeable against the Fish Commission Fund.

By balance on hand, July 1, 1888		$2,253 82
Receipts into the fund, fortieth fiscal year		3,444 23

By Expenditures.

Warrant No. 206—To T. W. O'Neil, supplies	$240 90	
No. 207—To L. L. Lewis, supplies	3 10	
No. 474—To Carquinez Packing Company, supplies	12 50	
No. 475—To John Ferrin, expenses	121 30	
No. 476—To W. H. Ewing, labor	36 66	
No. 477—To Stevens & Co., supplies	59 22	
No. 478—To J. L. Sutton, salary	100 00	
No. 479—To Bauer & Steffan, supplies	7 65	
No. 480—To E. J. Upham & Co., supplies	6 83	
No. 481—To G. A. Hastings, supplies	25 50	
No. 482—To John S. Benn, traveling expenses	10 50	
No. 483—To John F. Taggart, salary	50 00	
No. 484—To Charles Josselyn, money advanced	38 62	
No. 485—To J. J. Smith, labor	50 00	
No. 486—To John P. Dalton, salary and expenses	305 75	
No. 487—To James V. Geary, salary	110 66	
No. 488—To J. L. Sutton, labor	50 00	
No. 489—To John Ferrin, salary	209 79	
No. 597—To T. J. Sherwood, expenses	98 70	
No. 1032—To James Clyne, repairs	5 50	
No. 1033—To C. D. Dagnol, rent of sloop	152 66	
No. 1187—To J. Routier, traveling expenses	30 10	
No. 2997—To L. L. Lewis, supplies	3 10	
No. 2999—To Goldberg, Bowen & Co., supplies	9 80	
No. 2998—To Mohr & Yoerk, supplies	4 95	
No. 3000—To O. P. Egbert, supplies	11 75	
No. 3001—To John P. Dalton, expenses	100 50	
No. 3002—To Cooper's book store, supplies	8 50	
No. 4590—To W. A. Duncombe, rent of sloop	41 57	
No. 6162—To J. G. Woodbury, traveling expenses	208 91	
No. 6550—To T. J. Sherwood, traveling expenses	251 15	
No. 8891—To John P. Dalton, traveling expenses	151 95	
No. 8892—To John P. Dalton, supplies	15 00	
No. 8893—To Matt. Coffey, salary	35 00	
No. 8894—To Joseph Routier, expenses	91 40	
No. 11747—To Lauritzen & Frates, supplies	54 04	
No. 15459—To J. G. Woodbury, salary and expenses	239 39	
No. 15460—To J. G. Woodbury, salary and expenses	320 04	
No. 15728—To E. W. Hunt, salary	45 00	
No. 15729—To E. W. Hunt, salary	45 00	
No. 15775—To J. A. Richardson, salary	75 00	
No. 15776—To J. A. Richardson, salary	75 00	
No. 16650—To Edward Reilly, salary	91 90	
No. 16771—To T. W. O'Neil, painting	196 00	
No. 16791—To C. Folger, salary	50 00	
No. 16792—To M. J. O'Reilly, salary	1 50	
No. 16793—To John P. Dalton, salary and expenses	368 10	
No. 16794—To C. Elliott, salary	44 85	
No. 16795—To G. J. Sculley, salary	41 50	
No. 16796—To W. E. Elliot, salary	72 00	
No. 17017—To M. J. O'Reilly, salary	60 00	
No. 17055—To W. T. Robinson, expenses	37 00	
No. 17056—To San Francisco "Daily Report," advertising	40 00	
No. 18252—To M. J. O'Reilly, salary	30 00	
No. 18253—To J. C. Frazier, salary	107 20	
No. 18254—To John F. Moody, supplies	69 10	
No. 18255—To C. C. Folger, salary	33 20	
No. 18256—To G. J. Sculley, salary	50 00	
No. 18257—To Truckee Lumber Company, supplies	113 16	
No. 18258—To Carson and Tahoe Lumber Company, supplies	185 16	
No. 18259—To J. G. Woodbury	110 00	
No. 18260—To E. W. Hunt, salary, etc.	49 50	
No. 18261—To C. Elliot, salary, etc.	50 00	
No. 18262—To J. P. Dalton, salary, etc.	100 00	
Amounts carried forward	$5,393 16	

Amounts brought forward	$5,393 16	$5,698 05
No. 18263—To Thomas H. Powers, salary, etc.	40 00	
No. 18264—To Westgate, Dozier & Co., supplies	27 34	
No. 18265—To W. E. Elliot, salary	68 00	
No. 18266—To Edward Reilly, salary	150 50	
Balance on hand July 1, 1889	19 05	
Totals	$5,698 05	$5,698 05

EXPENDITURES

During the Forty-first Fiscal Year, ending June 30, 1890, chargeable against the Appropriation for the Restoration and Preservation of Fish in the waters of the State.

To appropriation (Statutes of California, 1889, page 438) $5,000 00

By Expenditures.

Warrant No. 1280—To John P. Dalton, salary and supplies	$62 50	
No. 1284—To Frank Anaya, salary and expenses	77 50	
No. 1285—To M. J. O'Reilly, salary	2 00	
No. 1287—To Henry Mathey, expenses	122 10	
No. 2219—To Edward Reilly, salary and expenses	193 85	
No. 2478—To T. W. O'Neil, painting	70 00	
No. 2486—To M. J. O'Reilly, salary	30 00	
No. 2487—To R. Lauritzen, supplies	20 33	
No. 2488—To Osborn & Alexander, supplies	14 45	
No. 2489—To Goldberg, Bowen & Co., supplies	12 38	
No. 2490—To O. P. Egbert, supplies	37 05	
No. 2491—To John P. Dalton, supplies	67 34	
No. 2492—To John P. Dalton, salary	100 00	
No. 2493—To John P. Dalton, rent	10 00	
No. 2494—To G. J. Sculley, salary	50 00	
No. 2495—To W. Lamonte, salary	28 00	
No. 2496—To John Howard, salary	36 65	
No. 2497—To W. E. Elliott, salary	60 00	
No. 2498—To C. B. Elliott, salary	50 00	
No. 2499—To C. Higgins, salary	26 00	
No. 3375—To J. M. Sullivan, salary and expenses	172 44	
No. 3376—To J. M. Sullivan, salary and expenses	193 20	
No. 3377—To Edward Reilly, salary and expenses	203 20	
No. 3378—To J. W. Hughes, professional services	75 00	
No. 3379—To M. J. O'Reilly, salary	30 00	
No. 3380—To M. J. O'Reilly, expenses	5 75	
No. 3765—To John P. Dalton, salary	100 00	
No. 3766—To John P. Dalton, expenses	10 00	
No. 3767—To John P. Dalton, expenses	124 77	
No. 3874—To Frank Anaya, expenses	271 15	
No. 3875—To J. Downey Harvey, expenses	14 00	
No. 3876—To Joseph Routier, traveling expenses	108 65	
No. 3877—To O. P. Egbert, supplies	37 60	
No. 3878—To R. Lauritzen, supplies	17 80	
No. 3879—To Osborn & Alexander, supplies	14 45	
No. 3880—To W. Lamont, salary	40 00	
No. 3881—To W. Markham, salary	50 00	
No. 3882—To G. J. Sculley, salary	50 00	
No. 3883—To W. E. Elliot, salary	60 00	
No. 4997—To Jno. T. Curley, expenses	77 10	
No. 5048—To M. J. O'Reilly, salary and expenses	33 10	
No. 5138—To John P. Dalton, expenses	119 25	
No. 5139—To O. P. Egbert, supplies	24 25	
No. 5140—To Osborn & Alexander, supplies	14 45	
No. 5141—To J. Downey Harvey, expenses	5 00	
No. 5142—To W. Lamont, salary	40 00	
No. 5143—To H. H. Briggs, salary	100 00	
No. 5144—To G. J. Sculley, salary	50 00	
No. 5145—To A. Cassidy, supplies	46 66	
No. 5146—To W. Markham, salary	50 00	
No. 5147—To W. E. Elliott, salary	60 00	
No. 5148—To John P. Dalton, salary	100 00	
No. 5149—To J. F. Curley, salary	66 30	
Amounts carried forward	$3,434 27	$5,000 00

Amounts brought forward	$3,434 27	$5,000 00
No. 5150—To Joseph Routier. expenses	31 00	
No. 5151—To F. P. Callundan, salary and expenses	114 65	
No. 5126—To M. J. O'Reilly, expenses	11 45	
No. 6473—To J. M. Sullivan, expenses	108 05	
No. 6474—To E. Reilly, salary	100 00	
No. 6475—To E. Reilly, salary	152 05	
No. 6505—To M. J. O'Reilly, salary and expenses	32 20	
No. 6749—To J. Downey Harvey, expenses	5 00	
No. 6750—To Joseph Routier, expenses	147 35	
No. 6751—To C. H. Bogart, expenses	16 70	
No. 6752—To C. E. Grunsky, salary	11 10	
No. 6753—To F. Anaya, salary	62 80	
No. 6754—To F. P. Callundan, salary	100 00	
No. 6755—To H. F. Williams, salary	50 00	
No. 6756—To John F. Curley, expenses	109 60	
No. 6757—To James H. Carothers, expenses	10 00	
No. 6758—To John P. Dalton, expenses	24 41	
No. 7437—To C. W. Thorrold, salary	50 00	
No. 7438—To F. P. Callundan, salary and expenses	132 25	
No. 7439—To F. Anaya, salary and expenses	78 45	
No. 7930—To M. J. O'Reilly, salary and expenses	32 55	
No. 8354—To E. Reilly, salary	100 00	
No. 8407—To F. Anaya, salary and expenses	12 70	
No. 8408—To J. Downey Harvey, expenses	5 00	
No. 8409—To Joseph Routier, expenses	30 00	
No. 11314—To M. J. O'Reilly, salary	30 00	
No. 13169—Wells, Fargo & Co., expressage	6 15	
Balance on hand June 30, 1890	2 27	
Totals	$5,000 00	$5,000 00

EXPENDITURES

During the Forty-first Fiscal Year, ending June 30, 1890, chargeable against the Appropriation for the Support and Maintenance of State Hatcheries.

Unexpended balance on hand July 1, 1889		$36 04
Warrants issued during the forty-first fiscal year for services performed during the fortieth fiscal year:		
Warrant No. 1296—To W. H. Schnittger, labor	$5 00	
No. 1297—To Jones & Givens, supplies	30 75	
		35 75
Unexpended balance fortieth fiscal year		$0 29
By appropriation (Statutes of California, 1889, page 438)		5,000 00

By Expenditures.

Warrant No. 2500—To W. H. Schnittger, salary	$5 00	
No. 2501—To J. A. Richardson, salary and expenses	78 50	
No. 2502—To J. C. Frazier, salary and expenses	100 50	
No. 2503—To E. W. Hunt, salary and expenses	61 50	
No. 2504—To Truckee Lumber Co., supplies	33 00	
No. 2505—To Fireman's Fund Insurance Co., insurance	15 00	
No. 3884—To J. G. Woodbury, salary and expenses	357 12	
No. 3885—To J. G. Woodbury, salary and expenses	141 50	
No. 3886—To W. H. Schnittger, salary	5 00	
No. 3887—To J. C. Frazier, salary and expenses	50 50	
No. 3888—To E. W. Hunt, salary and expenses	63 50	
No. 3889—To J. A. Todman, labor	15 00	
No. 3890—To John Hurley, rent	20 00	
No. 5131—To Carson and Tahoe Lumber Co., supplies	73 51	
No. 5132—To Whittier, Fuller & Co., supplies	10 00	
No. 5133—To E. W. Hunt, salary and expenses	37 75	
No. 5134—To. J. C. Frazier, salary	50 00	
No. 5135—To J. G. Woodbury, salary and expenses	205 35	
No. 5136—To A. J. Bayley, labor	21 50	
No. 5137—To Truckee Lumber Co., supplies	46 40	
No. 6759—To Wm. Boyle, labor	135 00	
No. 6760—To L. C. Nelson, supplies	15 00	
No. 6761—To E. W. Hunt, salary and expenses	79 15	
Amounts carried forward	$1,619 78	$5,000 29

Amounts brought forward	$1,619 78	$5,000 29
No. 6762—To Andrews & Barr, supplies	15 00	
No. 6763—To J. H. Sisson, supplies	31 10	
No. 6764—To J. G. Woodbury, salary and expenses	200 40	
No. 6765—To W. H. Schnittger, salary	10 00	
No. 6766—To Truckee Lumber Co., supplies	45 25	
No. 6767—To J. A. Richardson, salary and expenses	297 50	
No. 7931—To Liebenbaum Bros., supplies	38 95	
No. 7932—To J. M. Short, supplies	48 91	
No. 8405—To Sisson, Crocker & Co., supplies	43 61	
No. 8406—To W. H. Schnittger, salary	5 00	
No. 8410—To John F. Moody, supplies	46 66	
No. 9021—To Fireman's Fund Insurance Co., insurance	31 80	
No. 9022—To J. G. Woodbury, salary and expenses	152 25	
No. 9023—To Truckee Lumber Co., supplies	23 58	
No. 9024—To John F. Moody, supplies	88 42	
No. 9025—To J. A. Richardson, salary and expenses	163 90	
No. 9026—To J. C. Frazier, salary and expenses	66 33	
No. 9027—To E. W. Hunt, salary	75 00	
No. 9558—To Justinian Caire, supplies	49 01	
No. 9559—To W. F. Bowers & Co., supplies	10 00	
No. 9560—To W. H. Himes, supplies	6 00	
No. 9561—To L. C. Nelson, supplies	16 00	
No. 9562—To J. A. Richardson, salary	75 00	
No. 9563—To J. G. Woodbury, salary and expenses	144 60	
No. 9564—To E. W. Hunt, salary and expenses	78 00	
No. 10507—To J. A. Richardson, salary	75 00	
No. 10508—To J. G. Woodbury, salary and expenses	133 35	
No. 10509—To W. H. Schnittger, salary	5 00	
No. 10510—To L. Stone, salary and expenses	204 50	
No. 10659—To E. W. Hunt, salary	75 00	
No. 11575—To J. A. Richardson, salary	75 00	
No. 11576—To W. H. Schnittger, salary	5 00	
No. 11577—To J. G. Woodbury, salary and expenses	135 80	
No. 11578—To E. W. Hunt, salary	75 00	
No. 11579—To Sisson, Crocker & Co., supplies	95 91	
No. 11580—To The Bancroft Co., supplies	5 75	
No. 11581—To Southern Pacific Co., freight	22 85	
No. 11582—To Neville & Co., supplies	41 06	
No. 11583—To F. E. Drew, labor	25 00	
No. 12556—To E. W. Hunt, salary and expenses	92 90	
No. 12589—To J. G. Woodbury, salary and expenses	180 85	
No. 12590—To J. A. Richardson, salary and expenses	77 90	
No. 12591—To W. T. Bowers, expenses	5 50	
No. 12592—To Edson Brothers, supplies	61 50	
No. 12593—To W. H. Himes, labor	5 00	
No. 12594—To Leibenbaum Brothers, supplies	92 61	
No. 12595—To W. H. Schnittger, salary	10 00	
Balance on hand July 1, 1890	117 76	
Totals	$5,000 29	$5,000 29

EXPENDITURES

During the Forty-first Fiscal Year, ending June 30, 1890, chargeable against the Fish Commission Fund.

By balance on hand July 1, 1889		$19 05
Receipts into the fund, forty-first fiscal year		5,309 17

By Expenditures.

Warrant No. 1272—To W. E. Elliott, salary	$60 00	
No. 1273—To John Howard, salary	50 00	
No. 1274—To G. J. Sculley, salary	50 00	
No. 1275—To Thomas H. Powers, salary	40 00	
No. 1276—To John P. Dalton, salary	100 00	
No. 1277—To John P. Dalton, expenses	71 91	
No. 1278—To Charles Elliott, salary	50 00	
No. 1279—To John F. Moody, salary	20 00	
No. 1283—To Frank Anaya, salary	23 10	
Amounts carried forward	$465 01	$5,328 22

Amounts brought forward	$465 01	$5,328 22
No. 1288—To E. W. Hunt, supplies and salary	73 25	
No. 1289—To J. A. Richardson, salary	45 70	
No. 1290—To E. Reilly, salary	153 00	
No. 1291—To M. J. O'Reilly, salary	30 00	
No. 1292—To R. Lauritzen, supplies	13 65	
No. 1293—To Osborn & Alexander, supplies	14 45	
No. 1294—To Goldberg, Bowen & Co., supplies	14 00	
No. 1295—To J. C. Frazier, salary and supplies	104 50	
No. 2716—To J. G. Woodbury, salary and supplies	609 72	
No. 2965—To J. Downey Harvey, traveling expenses	192 00	
No. 4452—To C. Higgins, labor	95 00	
No. 5826—To J. Downey Harvey, traveling expenses	413 00	
No. 6768—To H. G. Miller, balance due on contract	16 40	
No. 6769—To "Sacramento Bee," advertising	24 00	
No. 7208—To John P. Dalton, supplies	5 25	
No. 7209—To John F. Moody, expenses	42 45	
No. 7210—To R. Radcliff, expenses	100 00	
No. 8369—To H. Dutard, rent of tug	49 50	
No. 8370—To F. P. Callundan, salary and expenses	207 25	
No. 9154—To E. Reilly, salary	100 00	
No. 9158—To M. J. O'Reilly, salary and expenses	31 40	
No. 9520—To Joseph Routier, traveling expenses	5 00	
No. 9521—To J. Downey Harvey, traveling expenses	5 00	
No. 9522—To F. P. Callundan, salary and expenses	199 50	
No. 9523—To Thomas Tumstead, salary	100 00	
No. 9524—To W. J. McDowell, expenses	16 80	
No. 9525—To J. F. Curley, expenses	7 25	
No. 9526—To J. F. Curley, expenses	28 50	
No. 10501—To F. P. Callundan, salary and expenses	109 00	
No. 10502—To J. D. Ennis, salary	100 00	
No. 10503—To M. J. O'Reilly, salary and expenses	33 85	
No. 11617—To Joseph Routier, traveling expenses	34 00	
No. 11618—To Joseph Routier, traveling expenses	30 00	
No. 11619—To J. D. Harvey, traveling expenses	5 00	
No. 11620—To J. D. Harvey, traveling expenses	5 00	
No. 11621—To F. P. Callundan, salary and expenses	130 50	
No. 11622—To Whittier, Fuller & Co., supplies	8 00	
No. 11623—To John D. Ennis, salary	100 00	
No. 12553—To Joseph Routier, traveling expenses	30 00	
No. 12554—To F. P. Callundan, salary and expenses	201 70	
No. 12555—To M. J. O'Reilly, salary and expenses	31 90	
No. 12599—To J. D. Harvey, traveling expenses	5 00	
No. 12600—To John M. Bailhache, expenses	6 00	
No. 12601—To John D. Ennis, salary	100 00	
No. 13184—To T. E. Sullivan, labor	22 50	
No. 13185—To W. H. Shebley, salary	52 25	
No. 13400—To M. J. O'Reilly, salary	30 00	
No. 13401—To E. D. Stewart, labor	68 55	
No. 13402—To S. F. Earl, labor	97 50	
No. 13403—To John D. Ennis, salary	130 50	
No. 13404—To John F. Curley, boat hire	30 00	
No. 13405—To J. Downey Harvey, traveling expenses	5 00	
No. 13406—To F. P. Callundan, salary and expenses	121 40	
No. 13407—To Joseph Routier, traveling expenses	30 00	
No. 13869—To T. W. O'Neil, labor	177 80	
No. 13885—To M. J. O'Reilly, salary	30 00	
No. 13886—To E. W. Hunt, salary and expenses	107 35	
No. 14045—To Joseph Routier, traveling expenses	30 00	
No. 14092—To John D. Ennis, salary and expenses	121 50	
No. 14093—To F. P. Callundan, salary and expenses	137 45	
Balance on hand July 1, 1890	44 89	
Totals	$5,328 22	$5,328 22

EXPENDITURES

During the Forty-first Fiscal Year, ending June 30, 1890, Chargeable Against the Appropriation for the Importation and Propagation of Game Birds.

To appropriation (Statutes of California, 1889, page 304)		$2,000 00

By Expenditures.

Warrant No. 8404—To "American Field" Publishing Company, advertising	$3 84	
No. 11313—To State Board of Fish Commissioners	500 00	
Balance on hand July 1, 1890	1,496 16	
Total	$2,000 00	$2,000 00

REPORT OF J. G. WOODBURY,

Superintendent of Hatcheries and the Restoration of Fishes, embracing the Operations carried out during the period between August 1, 1888, and October 1, 1890.

San Francisco, October 1, 1890.

To the honorable the Board of Fish Commissioners of the State of California:

Gentlemen: After being appointed Superintendent by your honorable Board on the first day of August, 1888, I visited Lake Tahoe, where Mr. Frazier was in charge of hatching the six hundred thousand eyed trout eggs, which had been contracted for by your honorable Board.

These eggs were being hatched in a rented building, small and windowless, and consequently giving insufficient light to distinctly observe the condition of the fish in the troughs, which is a very essential matter, for cleanliness is a cardinal virtue in the successful hatching and rearing of trout, and an abundance of light is necessary to perceive what one is doing.

The supply of water to the hatchery on a hot day was very precarious, diminishing in quantity in the middle of the day, and with cattle tramping up the ground around the springs, and the rotten condition of the wooden pipes which conveyed the water a long way to the hatchery, made it a very uncertain business in hatching trout, and kept the attendant in constant apprehension of some mishap.

It seemed a reproach to the California Fish Commission to be compelled to do its work of stocking Lakes Tahoe, Donner, Independence, Webber, and the mountain streams in the vicinity with fish under such adverse conditions as these. And if it is thought of sufficient importance that these waters be stocked with trout, it should be done from year to year, continuously, for intermittent work of this kind—stocking these waters for a year or two and then skipping a year—is work almost thrown away.

It occurred to me that the State should select some favorable point for shipping, and build its own hatchery, commodious and well appointed, with a certainty of plenty of cold spring water, and make Lake Tahoe a trout-hatching station as a distributing point for all these mountain waters.

Mr. Frazier reported that he shipped the trout, resulting from these six hundred thousand eggs, in 1888, to the localities and in the numbers given in the tables which accompany my report to your honorable Board.

THE SISSON SALMON HATCHERY, 1888.

The Board of Fish Commissioners had received word from Mr. Livingston Stone, who was in charge of the United States salmon hatchery on the McCloud River, that he would deliver at the McCloud River Station, free of charge to the California Fish Commission, four million eyed salmon eggs for stocking streams in this State.

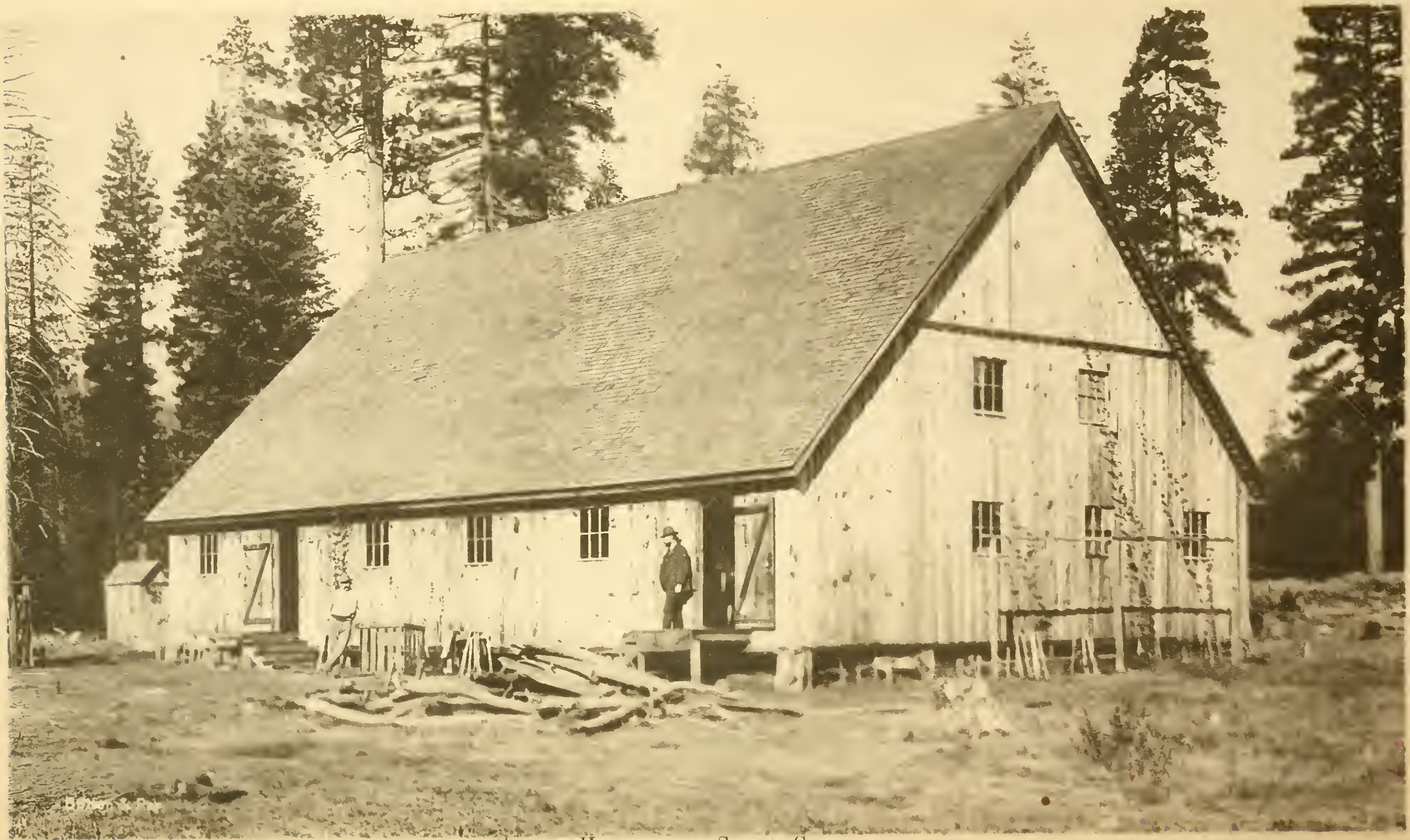
To take advantage of this generous offer on the part of the United States Fish Commission, I immediately, on my return from Lake Tahoe, started to look up a place on the headwaters of the Sacramento River for the erection of an extensive hatchery to accommodate this large number of eggs when hatched out. The necessary conditions for hatching out so many eggs, and the large trough space for nurseries to keep in good condition the young fish until they are old enough to ship, are a good sized stream of pure, cold spring water with no possibility of floods washing out the ditches or flumes that take the water to the hatchery, and with a right at all times to control a sufficient quantity of water for all purposes. It was also essential that the hatchery should be at a convenient distance from the railroad station and a telegraph office for convenience of shipping the fish to distant points; also, a point on the river, whence it was, owing to its accessibility, the cheapest to reach by wagon road the greatest number of the branches of the headwaters of the Sacramento River. For the shipping of even one million of young fish to distant points and properly distributing them over the nursery grounds is a costly and tedious operation.

After examining the Sacramento River for the best place in my opinion, I selected, with the consent of Mr. J. H. Sisson, a site in the field back of his barn about three quarters of a mile from the railroad station in the town of Sisson. The spot selected is well drained, sunny, and sheltered from the prevailing winds, and with an open view of old Mount Shasta.

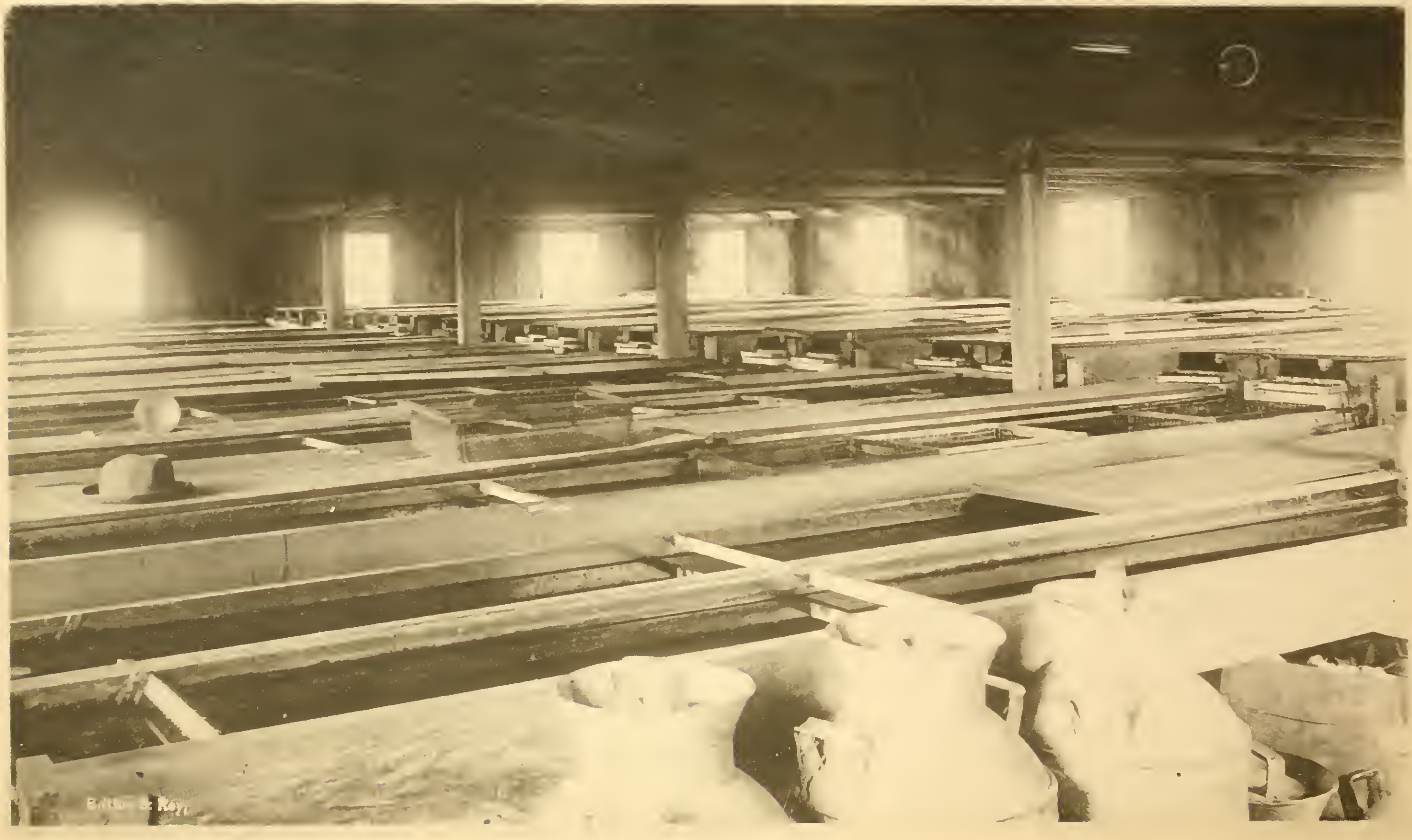
The water for the hatchery comes from a large spring, about one and a half miles distant, which forms the extreme head of one of the branches of the Sacramento River. Its volume is sufficient to run a sawmill, and its temperature is 46 degrees Fahrenheit at all seasons. The main ditch from this spring runs near by the hatchery. It seemed to be an ideal place for a hatchery, and also most conveniently situated for distributing the fish to the proper nursing grounds. In the two years of experience since the hatcher was built, in hatching the millions of trout and salmon eggs, the expectations have been more than fulfilled. The waters seem to have a marvelous virtue in maintaining the health of the young fish as well as having a sparkling taste to the palate. The hatchery was built in expeditious haste to prepare it in one month for the reception of the expected salmon eggs from the September run of fish at the McCloud River Hatchery.

The hatchery is a plain building forty feet by sixty feet, strongly built, with a half pitch roof which has resisted the tremendous snows of the past winter. It has a capacity for forty-four hatching troughs sixteen feet long and sixteen inches wide. The troughs are made of one and one half-inch dressed pine, and are painted with three coats of asphalt varnish to prevent the wood from growing a fungus, which would destroy the young fish. A head trough sixteen inches square, prepared in the same way, runs the entire length of the building, sixty feet, which furnishes water through gates to the hatching troughs. A large filtering tank outside, and a flume about one hundred yards long, connect the hatchery with the main ditch. The hatchery has a system of troughs beneath the floor to carry off the water from all the hatching troughs to a waste ditch outside.

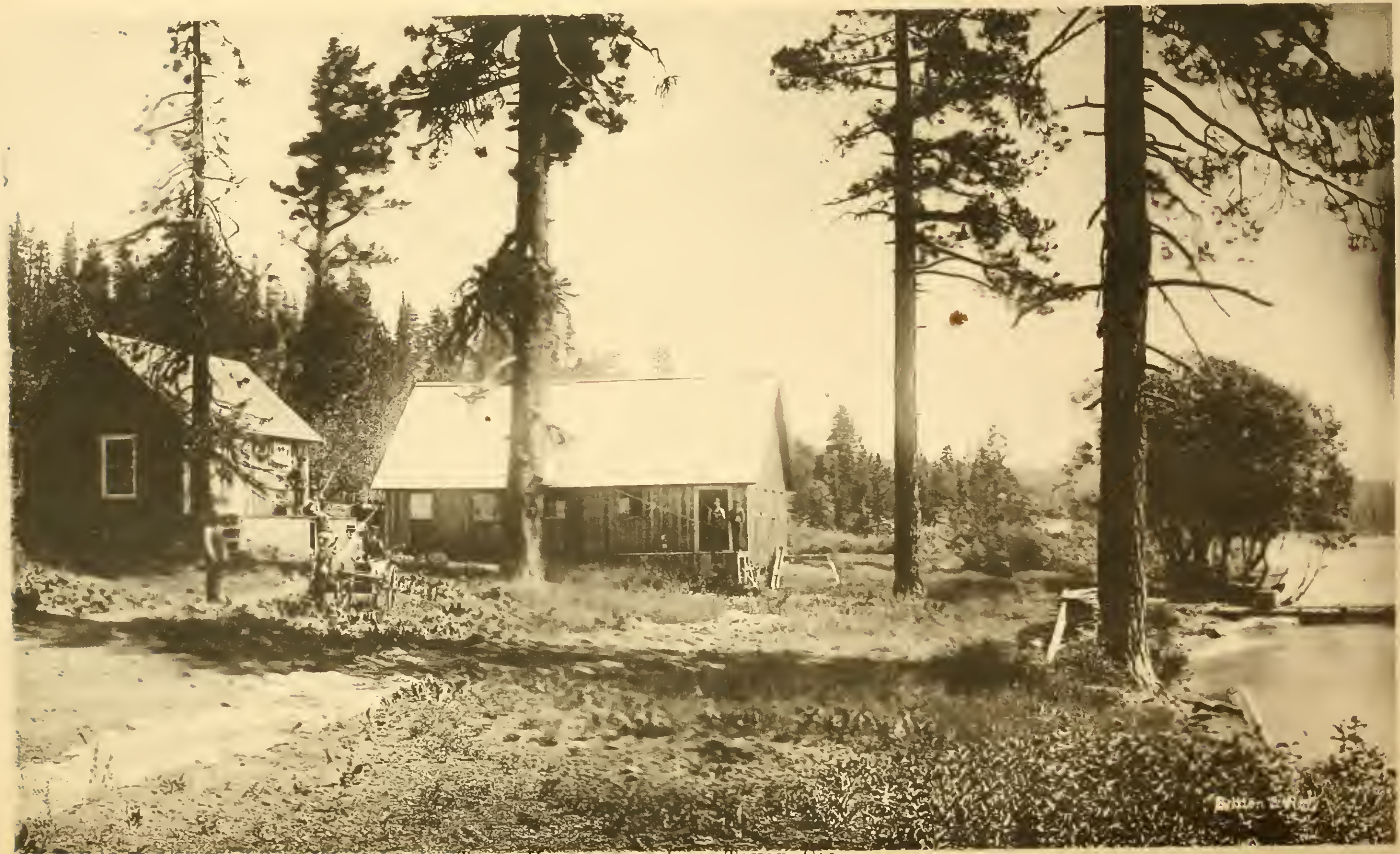
A room fourteen by sixteen feet, for the men to live in, was finished in the upper part of the hatchery.



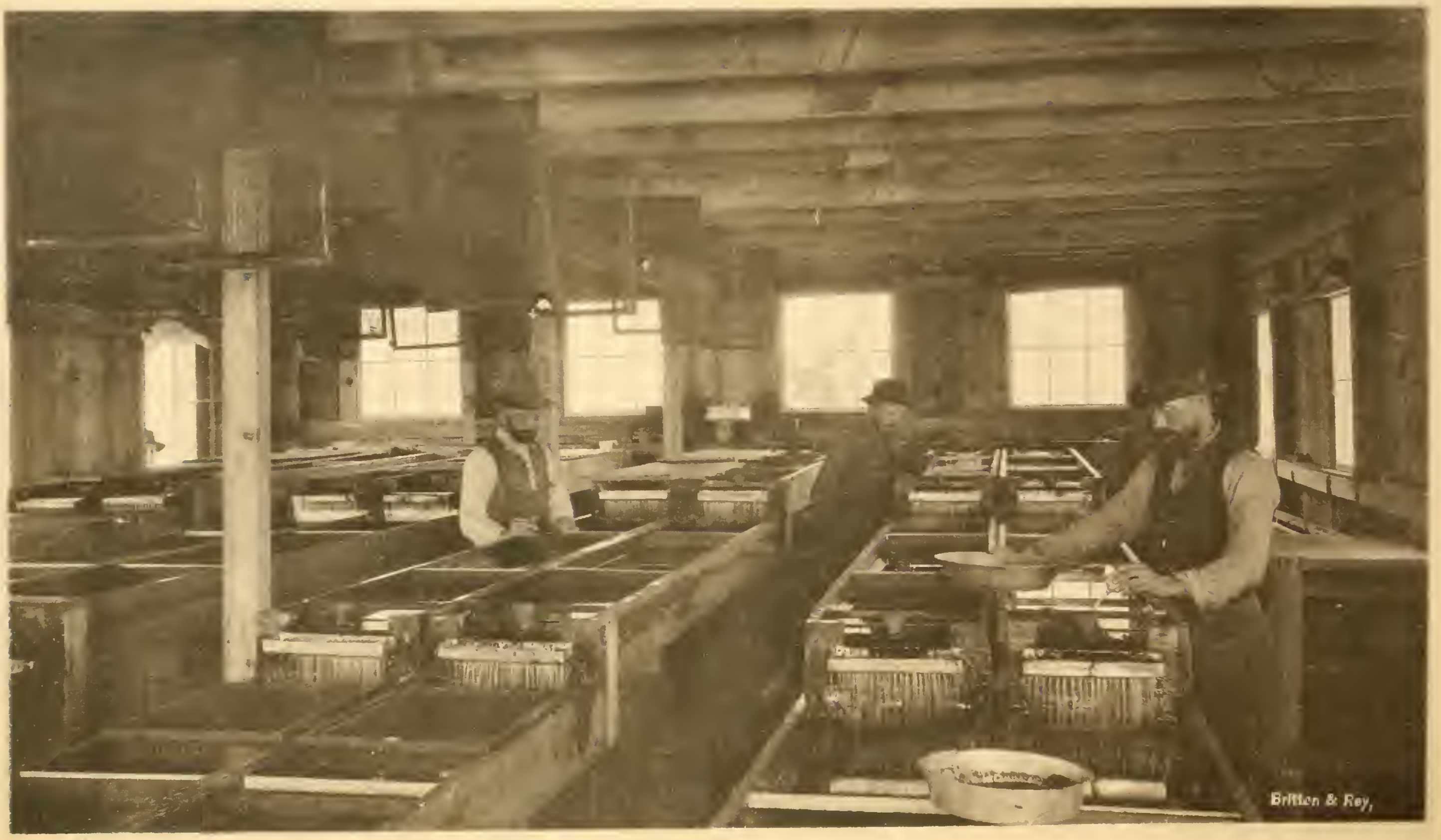
Salmon Hatchery at Sisson, Cal.



Interior of Hatchery at Sisson.



Trout Hatchery at Lake Tahoe, Cal.


Britten & Rey,

INTERIOR OF HATCHERY AT LAKE TAHOE.

Each trough has screens and covers to protect the eggs from the light. One hundred and fifty wire hatching baskets were made and painted with asphalt varnish. It seemed to be an endless task to get this large hatchery finished. We worked every day in the week, and most of the nights until ten and eleven o'clock, painting the troughs, making the baskets, covers, etc., and fixing up the living-room. This work continued long after the first lot of eggs were received.

This hatchery is well equipped and is also one of the largest in the country. It has a third larger capacity than the United States Salmon Hatchery on the McCloud River, where fourteen million salmon eggs have been eyed at one time.

Before shipping the eggs, Mr. George B. Williams, Superintendent of the station at Baird, where the United States Salmon Hatchery is located, sent word notifying us of the date of shipment. The salmon eggs are hauled to Smithson, on the Sacramento River, where one of our men meets them with ice to be put in the packages to keep them cool. The State Fish Commission pays all expenses incurred on the shipment of eggs from the McCloud River to Sisson. The United States Fish Commission generously donates the eggs, eyed and packed, ready for shipment, from the Government Hatchery on the McCloud River.

We received at the Sisson Hatchery, from the September run, 1888, about eight hundred thousand salmon eggs, instead of the three or four million which were expected to be taken during that month. This caused a great surprise and disappointment, for ten years ago during the same month twelve million eggs were easily taken. This shows what havoc the fishermen with their nets are making in the lower Sacramento River.

This year, 1888, the United States Fish Commission renewed their operations on the McCloud River, that station having been abandoned during the previous five years. The eight hundred thousand eggs received from them were hatched out at Sisson, and kept till old enough to be planted, and during the month of December were distributed in branches of the Sacramento River, the West Fork, Salloway Creek, Big Spring Creek, Cold Creek, and in the main Sacramento below the eighteenth crossing.

The Government Station on the McCloud River did so poorly in the August and September run that they continued their efforts for the taking of more spawn during October and November. This had been unusual in former years, because they got all they required in the first run. Usually the McCloud River rises in volume during the fall rains, which makes it very difficult for the men to keep their traps in the river (as, for instance, during last year, 1889, when everything was swept away).

We received at the Sisson Hatchery from the October and November run, 1888, about two million two hundred thousand salmon eggs. The eggs arrived during the last of December and part of January, 1889. These were hatched out in fine condition, and kept till old enough to ship, and were distributed, in March and April, in the same streams as those of the September run; and, also, down the Sacramento River as far as Big Castle Creek. In shipping these fish down the river the Southern Pacific Railroad Company very generously loaned us the use of a hand car, and gave the right of way on their road. Without this accommodation it would have been almost impossible to have distributed the fish properly. With the good water at the Sisson Hatchery, and the care they received from the attendants, Mr. James A. Richardson and Mr. E. W. Hunt, I venture to say that no fish were ever hatched out with a less percentage of loss.

In the fall of 1888 a contract was made with Mr. Livingston Stone, at the United States Hatchery on the McCloud River, to hatch out from the eyed eggs which the United States Fish Commission donated to the California Fish Commission, five hundred thousand young salmon at 75 cents per thousand, and distribute them in the McCloud River.

The United States Fish Commission also very generously hatched out and planted in the McCloud River the same season one million young salmon at its own expense; and, also, in 1889 the United States Commission planted eighty-four thousand young salmon in the McCloud River. More would have been planted there that year by the United States Commission, if the floods had not washed out the traps and thus prevented the taking of any more breeding salmon.

Mr. J. H. Sisson generously gave two lots in the addition to the town of Sisson, each thirty feet by one hundred and forty feet, for the use of the hatchery, for $1 a year with the free use of the water; and, also, he signed a bond to give the Fish Commission permission to remove the buildings, or else buy the land at the market price, with a perpetual free use of all the water from Big Springs Creek which the hatchery should need. These lots should belong to the Fish Commission, with one or two more of the adjoining lots on the south included.

Mr. Dunn, the Controller, claims that under the present law the Fish Commission has no right to purchase land for its hatcheries. I would suggest that your honorable Board petition the next Legislature for a law to be passed granting the Fish Commission the right to purchase land for its hatcheries when a desirable locality has been fixed upon.

If the hatcheries do any good in maintaining the normal supply of food fish by restocking the streams, and if it is advisable to operate the hatcheries for a few years, it is equally important to maintain them for all time. The State consequently should own and operate its own hatcheries as a permanent institution.

As soon as the young salmon were all distributed (April, 1889), the hatchery was closed at Sisson for the season of 1888–9.

LAKE TAHOE.

Operations were now immediately begun at Lake Tahoe. The fishermen said that the month of May was too late a date on which to take spawn at Taylor Creek, which was considered the best place for getting the most spawn. But we managed by careful seining to get about one hundred and fifty thousand trout eggs here, which were put into the old private hatchery at Tahoe City. Taylor Creek is at the upper end of the lake, about twenty miles from the hatchery. Work was then begun on traps to be put in the creeks near their mouths. We had to wait for the lumber to be sawed out at Truckee and hauled over what was, at that time, a bad road. This delayed us somewhat, but as soon as possible we had traps in Meek's, Phipps', Blackwood, and Ward Creeks. Trout run up these creeks later than they do in Taylor Creek, for the reason that these streams are fed by melting snow water which is cold and often roily, while Taylor Creek has its source in Fallen Leaf Lake, which modifies the temperature of the small streams running into it.

In Meek's Creek the trout had been running some time before we put in our traps, and Chinamen had been catching them by torchlight, so the fishermen said. The run dwindled down very fast and we caught but few trout, but the traps were full of suckers.

In Phipps' Creek, which is later than Meek's, the trout had not begun to run when the traps were set; the water was very low. We caught here but very few fish during the season. Trout used to run up this stream in large numbers, but a trap had been kept here for years past to catch the fish, principally for the market, and I could not learn if any young trout had been planted in the stream to restock it in place of those which had been prevented from going up to spawn.

The next creek, Blackwood, is a larger and later stream for trout; in this creek we caught the greater bulk of our eggs. We had to continue trapping in this creek a long time—into August, in fact—when the water became very low.

In Ward Creek but very few trout were caught.

We also seined at the Incline in Nevada, by permission of Fish Commissioner Mills. Here formerly trout used to be caught in great numbers by the same fishermen who worked this season for us. This year, however, but few fish could be seined, while cart loads of sawdust were drawn in by the seine. The two streams which empty into the lake at this place were very low.

We took this season, 1889, about one million two hundred thousand eggs. It was expensive to keep the traps in for so long a time with men to attend them. Spawn taking had been continued through three months, while in an ordinary season, and to get two million five hundred thousand eggs, it was expected that the work of spawning would be done in six weeks. The cause given why so few fish could be caught was that it had been an open winter around the lake, scarcely any snow had fallen, and the water consequently in all the streams was very low. It is the melting of the deep snows in the mountains that cause the streams around Lake Tahoe to rise in April, May, and June. All the traps and seining grounds were at distant points from the hatchery. The eggs had to be brought around the lake on the steamer or in rowboats.

In the first part of this report mention is made of the old private hatchery, where the Commission was having trout hatched, of its inadequate qualities, of the insufficiency of water for hatching purposes, and the insecurity of supplying pipes. It seemed necessary that the Fish Commission of this State should have a hatchery of its own, sufficiently large to take care of fifteen hundred thousand trout, with a good supply of cold spring water.

A State hatchery at Lake Tahoe would be the most central, as a point of distribution, for the great Tahoe, Donner, Independence, and Webber Lakes, as well as the Truckee River and its branches, and also the headwaters of the different forks of the American River, and rivers farther south, rising at the summit of the Sierra Nevada Mountains—these latter being stocked with Eastern trout alone, while all the former could be stocked with Lake Tahoe trout, Eastern trout, and the land-locked salmon.

Lake Tahoe is of considerable importance as a resort for health and pleasure by tourists from the East, as well as large numbers of our own people. Boating and fishing are among its pastimes. Travel here must increase as our State becomes more thickly populated. All these waters were well stocked with trout in former years, when the Truckee River was open to the passage of trout from Tahoe to Pyramid and Echo Lakes. The magnificent spawning grounds of the whole length of the Truckee River were then used by the trout to deposit their eggs. In almost countless numbers the trout made their way from Pyramid and Echo Lakes to Lake Tahoe. But since the dams have been built on this river no trout can get up to Lake Tahoe, and of late years trout have been diminishing above the lower dam very fast.

Taking all these things into consideration, I thought it best to build at Lake Tahoe a new State hatchery.

THE NEW STATE HATCHERY AT LAKE TAHOE.

Soon after arriving at the lake, and while the other work of seining and trapping was in operation, I began to look up a place to build, with the necessary conveniences for hatching and shipping. A spot near Tahoe City was selected, where there were some fine springs near the shore of the lake and quite close to the steamer landing.

No one could tell me where the owner could be found, or even what his name was. But in the hurry for a safe place to hatch the spawn which was being taken (the first few lots were placed to the old private hatchery, which was hired for the purpose), I had determined to build a temporary hatchery on the place selected, and trust to luck in finding its owner and buying it of him. So I ordered lumber from the mill at Glenbrook for the building, and had the hatching troughs made at the factory in Truckee. Wire for the hatching baskets was ordered from San Francisco. A man was put to work getting out sills for the foundation of the permanent hatchery. Other men were set to digging ditches to bring in water from the springs to a new reservoir to be made near the lake shore. As soon as the lumber and troughs arrived, a temporary roof was put up. Some of the troughs were painted and prepared for the eggs. After the troughs were in place, and the flume to the head trough finished, and the water was running in the hatching troughs, we brought the eggs from the old hatchery to our temporary new one. We felt much relieved now, for we could take care of the eggs as fast as they came in, and had the eggs which were in the old hatchery in a safe place—the old rotten pipe had already burst several times, and we had been harassed with fear of losing the eggs.

At this point of our work I started for San Francisco to find the owner of the place on which I wished to build the new hatchery. After considerable trouble and delay, I found the owner of the springs, and after making a bargain at a fair price for the land, and a guarantee to give me a month to search the title, I returned to Tahoe. We at once began work on the new hatchery, laying a strong foundation with heavy sills to bear up the weight of water and heavy winter snows.

The building is twenty-four feet by forty-two feet, strongly built, with a half pitch roof. It has seventeen windows, which give abundance of light. The plan of the hatching troughs is like those at the Sisson Hatchery, with twenty-four troughs twelve feet long, and sixteen inches wide—with head trough and a large settling tank outside connecting with a flume, which brings the water down for about two hundred yards from the springs.

As soon as the building was ready and part of the troughs had been placed in position, we transferred the baskets of eggs and young fish from the temporary hatchery to the new building; the remaining troughs were then put in place.

The troughs are well made, of sugar pine, and painted with two coats of asphalt varnish. A good supply of new hatching baskets, painted with varnish, and covers made for all the troughs.

The hatchery is well appointed, strongly built, and roomy.

It was necessary to do all this work as quickly as possible, and, in doing it, there were many vexatious delays. No supplies for the work could be obtained at Tahoe, except lumber in the tree. The shakes for the roof had to be made, the sills had to be hewn from the tree, and, as no teams get in there until the loggers arrive, we were much delayed in hauling the sills and shakes. The lumber had to be sawed and brought over on scows from Glenbrook, then rafted and got inshore as close as possible, then thrown into the water, pushed ashore, dragged out and packed up to the building.

Lake Tahoe is a very difficult place to collect spawn. The traps are all at distant points. In going to one on the steamer it takes all the next day to get back, as the steamer has to go round the lake to get home. To go to the traps off the regular route of the steamer rowboats must be used, which takes half a day to go the round trip. On many days the lake is so rough that it is not possible to go in a boat. We had a very busy summer's work; all hands were employed every Sunday, as well as through the week days.

Of the thirteen acres which were bought for the hatchery, the greater part consisted of wet land through which the springs flowed. This naturally produced the best feeding ground for cows. As soon as the grass began to spring up, about two hundred head of cattle were driven into the neighborhood of Tahoe City, and they made our springs their headquarters. They would wade in all through that soft ground among the alders, tramping it up, and the water in the hatchery would be black with mud, covering the eggs and thickly settling on the bottom of the troughs.

We had to endure this annoyance for weeks, leaving our work in the day time to drive them off, and watching the place till ten o'clock at night, till the wire for fencing ordered from Sacramento arrived, the posts split, the holes dug, and fence put up to protect ourselves from their raids.

Later in the season, when most of the fish were shipped and more leisure obtained, a line ditch was dug from the reservoir to the main spring, and a strong flume of two-inch planks was laid and covered up. This was to keep the water from getting heated upon a hot day. Also, a new house for quarters for the men was built, sixteen feet by twenty-four feet, with three rooms, boarded and battened outside and close boarded inside, making a strong, well built, and warm house. A new stove and housekeeping articles were bought. Our men did their own cooking after the first of August, the Commission furnishing the supplies, thus saving large board bills at the hotel.

After I had made a bargain for the land, your honorable Board sent me word that Mr. Dunn, the Controller, said that he had no authority to issue a warrant to pay for land for the Fish Commission. As the buildings were already begun, and as there was no other course to pursue but go ahead, I wrote your honorable Board that I would buy the land myself and rent it to the Commission at a nominal sum.

After the spawn was all taken, about the first of August, I sent Mr. Richardson to the city to begin shipping Black bass from the Spring Valley Water Company's lakes.

Mr. Hunt stopped at the hatchery till most of the young trout were shipped in the latter part of September. He then went to the Sisson Hatchery to receive the first lot of salmon eggs from the United States Hatchery on the McCloud River. I had already been up there (August), and painted the troughs with asphalt varnish, and turned on the water to soak them in readiness for the September run of salmon eggs.

I stopped at the Tahoe Hatchery, working on the house and flume most of the time until both were finished.

The fish being all shipped, the house and flume finished, several cords of wood got into the house for the next spring work, the hatchery was closed up on the last of October, 1889.

The distribution of this season's trout (1889) at Lake Tahoe will be seen on reference to the tables.

BLACK BASS.

Seth Green brought the first Black bass to California. These were brought out at the expense of a sportsmen's club, and placed in Temescal Lake, near Oakland. A few waters have been stocked from the young of these bass.

The second lot of Black bass was brought out by B. B. Redding, for the California Fish Commission, and planted in the Crystal Springs reservoir, near San Mateo, with the permission of the Spring Valley Water Company, for breeding purposes, with the privilege of shipping the progeny of these fish to stock the waters of this State.

The Black bass is a splendid game fish, fighting bravely and fiercely for its liberty, many anglers claiming that there is more sport fishing for them than for trout. They are also a delicious fish to eat. They will do well in almost any of our fresh waters, either rivers or lakes; they multiply very rapidly, and require no aid from artificial propagation. When waters are once stocked with them, they are to stay, if fair play is shown them. They should be protected for several years till the original stock has had a chance to breed two or three times, and afterwards no fishing should be allowed for several months during the spawning season. Like any other live stock, if breeders enough are not reserved, the stock will become diminished.

The Black bass, like Striped bass are ravenous feeders; they will devour the Sticklebacks, which almost all fish avoid on account of their spines.

Not many of our public waters have been as yet stocked with these fish. They should be, for when once they become stocked with Black bass it is done for all time.

Clear Lake, in Lake County, will make, when it has been well stocked with Black bass, a splendid and extensive resort for anglers. There is an inferior fish there which breeds in myriads, which will give grand feasting for Black bass.

It was thought to be high time that some systematic work should begin to stock all the waters of our State that are proper to plant with bass: Clear Lake, the Blue Lakes, Tulare Lake, Goose Lake, and many smaller lakes in our State, and perhaps the great Klamath Lakes. Probably it would not be well to plant Black bass in Tahoe, Donner, Independence, or Webber Lakes.

The rivers Kern, King, and so forth, are admirably adapted for the home of this fish. I am not over confident that it would be safe for the young salmon to have the Black bass planted in either the Sacramento or San Joaquin Rivers.

The young salmon make the Sacramento River their highway from the nursery grounds in the McCloud and upper Sacramento Rivers to the ocean, and they would have to run the gauntlet of the Black bass if the latter were planted there. But the perch and the Sacramento River pike, which have always been there, would also be salmon eaters, if they could catch them. The question remains: Would the Black bass be any more destructive than their first cousin, the perch? At any rate, in time these fish will find their way into these rivers, clandestinely by private parties, if not done so openly by the Fish Commission. Russian River is, I understand, at present well stocked with Black bass.

Many applications have been made for Black bass to stock waters in different parts of the State. They have to be caught for shipment with hook and line. If they swallow the hook it is liable to injure them, and cause them to die while kept in confinement waiting for shipment, or on the journey to be planted.

When fish are shipped to private waters, the expenses of the journey, transportation, railroad fares, hotel bills, etc., are expected to be paid by those who make application for them. Fifty fish, such as would breed for the first time during the following spring, are sufficient to stock any reservoir or small lake. The number did not exceed twenty which were originally placed in Crystal Springs reservoir.

Mr. James A. Richardson, after leaving the Tahoe Hatchery, in August, 1889, began shipping the Black bass, making one trip to the waters near Oroville, for Senator Jones, one to Sweetwater reservoir, San Diego, and two shipments to Clear Lake. More shipments would have been made that year, but Mr. Richardson became seriously ill, and had to postpone the work.

SISSON HATCHERY, 1889-90.

The salmon hatching season opens about the latter part of September. Mr. E. W. Hunt, after leaving the Tahoe Hatchery, in September, 1889, went up to the Sisson Hatchery to receive the first consignment of salmon eggs from the United States Hatchery on the McCloud River. There were shipped of the August and September run nine hundred and seventy-four thousand salmon eggs, and of the later run in October and November, three hundred and fifty-five thousand salmon eggs. In all, for 1889 only one million three hundred and twenty-nine thousand eggs.

The reason why this small number of eggs (three hundred and fifty-five thousand) was received in the second run from the United States Hatchery, was because of the heavy early fall rains, which raised so great a flood in the McCloud River that it swept out all their traps, and put an end to all fishing for that season. This shows how important it is that the close season for salmon should be so definitely fixed that sufficient numbers of breeding salmon should reach the United States Hatchery in the month of September, so that a sufficient supply of eggs for artificial hatching could be caught at that time to supply the young for stocking the rivers of our State, and not depend upon the late fall run, which is so uncertain on account of the liability to floods, which makes it impossible to secure the salmon.

The young fish from the first run of salmon eggs were compelled to be kept, on account of the furious snowstorms of the past winter, till in February and March, of 1890, and then distributed, the boys using snowshoes and hauling them out on handsleds. The second run was kept till March and April, and was distributed, same as the first lot, in the Sacramento River and its branches. Many difficulties had to be encountered this year, owing to the great snowstorm. For weeks there was almost continuous shoveling of snow, to keep it away from the windows of the hatchery, to obtain some light to enable the attendants to see to do their work.

The young fish had to be put on short rations during the great snow blockade, on account of the scarcity of meat.

EASTERN BROOK TROUT.

The Eastern Brook trout, with its brilliant scarlet spots, mottled green back and lower fins red and fringed with white, is one of the most beautiful fish in the world. It is gamey and has a delicate flavor.

Our first Board of Fish Commissioners thought they would be a valuable acquisition to our trout streams. They introduced the eggs of these fish from New Hampshire in 1876; these were hatched out and distributed from their first hatchery on the University grounds at Berkeley. They continued the introduction and hatching of these fish for several years. The fish were distributed in many hundreds of thousands into the streams of Alameda, Marin, San Mateo, Santa Cruz, Santa Clara, and Monterey Counties; also, in the high Sierra Mountains, above the falls of the Yosemite Valley, on the headwaters of the Yuba and North Fork of the American River, Prosser Creek, a branch of the Truckee River; also, in Cold Creek, at Sisson, a small branch of the headwaters of the Sacramento River. In all these short coast streams, which become warmer and diminished in volume as the summer advances, they have not reproduced themselves—at least, I cannot learn that any have been caught for a number of years past; but in all the high Sierra streams where these trout were planted, they can now be caught quite plentifully. The integrity of their characteristics in all their virgin beauty is maintained. A number of these fish were caught during the past summer in Blackwood Creek, Lake Tahoe.

About four years ago a few of these fish were planted in a small lake on the mountain side back of McKinney's place, Lake Tahoe. Last year Mr. McKinney told me that a number of Eastern trout had been caught in that little lake, one of which weighed three pounds. He said they were fierce fighters, and had a delicious flavor. Some of these Eastern trout have been caught thirty miles down the river from the place where they were first planted in the North Fork of the American River. It seems to me very probable that the Eastern Brook trout, as they become older and larger, will drop farther and farther down the main stream and ascend other branches to spawn, and, thus becoming acclimated, will gradually stock all the streams in the State accessible from the first stream in which they were planted. From the Tahoe Hatchery, Lake Tahoe: Fallen Leaf Lake and the streams which empty into these lakes, the numerous small lakes on the mountain sides, the

Middle and South Forks of the American River, as well as the headwaters of other rivers farther south; also, the North Yuba and Feather Rivers could be stocked with these Eastern Brook trout.

From the Sisson Hatchery, these trout could be planted in the headwaters and branches of the Upper Sacramento and McCloud Rivers, and also in the headwaters of the Trinity and Klamath Rivers.

It seemed to me to be such a public good that these trout should be systematically planted in all these mountain streams, so that anglers could catch these speckled beauties during their vacations for health and pleasure, that I asked of your honorable Board permission to buy one hundred thousand Eastern Brook trout eggs. They were shipped from Mr. Livingston Stone's trout hatchery, Charleston, N. H. These eggs were hatched out during the past winter at the Sisson Hatchery. From these eggs, which came about four thousand miles, we got about eighty thousand of fine, healthy trout; these were kept in the hatchery for several months waiting for the snow to melt so that the roads could be opened to the McCloud River and other places. As soon as these fish could be shipped, about thirty thousand were planted in spring brooks which feed the upper McCloud River, near the Horseshoe Bend at the eastern side of Mount Shasta. Twelve thousand were planted on the application of Senator Stanford in Deer Creek, a fine stream which rises in the Sierra Nevada Mountains and empties into the Sacramento River, near Vina. The balance of the trout were planted in the West Fork of the Sacramento River, and also in School House Spring and Kaiser's Creek, branches of the upper Sacramento River; also, in the headwaters of the Shasta River, Griffin's Springs, Wadsworth Springs, Big Springs, and in Shovel Creek, branches of the Klamath River. The Eastern Brook trout cannot but do well in all of these places, as there is plenty of food and the water is cold. I consider that it is worth all the expense and trouble many times over to have the famous McCloud River stocked with these fine fish. In order to get these waters well and permanentely stocked with these fish, several years of continuous stocking should be done.

TROUT HATCHING AT SHOVEL CREEK, 1890.

There had been complaints because no trout had been planted in the vicinity of the bay of San Francisco during 1889, but as a food fish was of the first consideration, a hatchery large enough to accommodate the donation of salmon eggs from the United States Government had to be erected. The Tahoe Hatchery was built during the next spring and summer, and the season's work carried on there. This work was all done in hot haste, and, with shipping the Black bass, we had no time to spare. Our help was all engaged and the money getting short.

To ship trout from Tahoe to streams around the bay would take at least four days' time, and the trip is very expensive, nearly $100 a trip.

These two large hatcheries, with appointments and quarters for the men, with the large number of salmon and trout distributed, were paid for solely from the regular appropriation.

To meet the wants of the anglers in having the streams stocked with trout, I began to prospect early in the winter of 1889 for a station where the Rainbow trout could be caught in sufficient numbers to make it an object to build a small hatchery, eye their eggs and then ship these eggs to the Sisson Hatchery, hatch them out and from there ship the young fish to stock the streams of the State as well as possible.

The Shasta River, in Siskiyou County, had been famous for its great numbers of trout. I looked at that and made close inquiries, and found that but few trout run up that stream now in comparison to the great numbers that formerly did so. And no wonder, for the water has been taken out of that river for years, and from the famous springs which help to supply its volume of water, through open irrigating ditches, with no screens to keep the trout from being drawn in and distributed through the grass to die. A gentleman, who formerly owned a farm near Edgewood, told me that he had found fully thirty thousand dead young trout, which he discovered in holes after the water in his ditch had been turned off. This number is one instance. Now, taking the same ditch through the whole season and adding this to the other ditches in Shasta River Valley, and the numbers of trout destroyed in this way would amount up into the millions.

I also heard of the Shovel Creek, at the Klamath Hot Springs, as a wonderful trout stream. I visited that place, and received the generous permission of the Edson Brothers to trap that stream for trout spawn and establish a small hatchery on their grounds. I was told, however, that but few salmon and trout had made their appearance there during the preceding fall, on account of the dam which had been put in at Klamath City. It had been complained of, and a small fish ladder had been put in, large enough for a small stream, but a wee thing for such a roaring river as the Klamath, with its immense volume of water pouring through the sluiceways with such force that a trout could not stem the current. The fish ladder, with its minute quantity of water, was away at the end of the dam, next the bank, where only a straggling trout or salmon would find its entrance.

I felt discouraged at the prospect of finding a good place for a trout hatchery. The heavy storms drove me home, but as soon as the snow blockade was broken I went up to that region again, and found that the elements, although fierce, had been propitious to trout, which by instinct were compelled to seek the upper Klamath for spawning beds, for the great volume of water, higher than ever known before, had ripped out the dam at Klamath City, and the trout had an unobstructed highway.

I immediately began, early in March, 1890, fitting up a small building, which Mr. Edson loaned me, with hatching troughs flumed in the water, and began building traps for Shovel Creek. The hatching baskets for trout eggs had been built at the Sisson Hatchery during the winter in anticipation of using them there.

Shovel Creek is quite a large stream which empties into Klamath River, within the grounds of the Klamath Hot Springs Hotel. Many of the trout which were spawned would weigh two and one half pounds.

After getting the hatchery in working order and a few thousand trout spawn taken, leaving Mr. Richardson in charge, I went to the Sisson Hatchery and left Mr. Stewart in charge to distribute what salmon were left, to look after the Eastern trout which were being kept until the roads would be open to ship part of them to the McCloud River, and also to receive the trout eggs which were to be sent from the Shovel Creek Hatchery.

TAHOE HATCHERY, 1890.

I now proceeded, accompanied by Mr. Hunt, to Lake Tahoe to open the spring campaign there. The road not being open from Truckee, we had to go up by way of Carson.

On arriving at the hatchery, our house we found buried in snow—it had been twelve feet deep on a level, but in places the wind had drifted it to a great height. After putting new wings to the bag of the old seine, we hired the steamer Tod Goodwin to take our traps, seines, boats, bedding, and provisions up to the mouth of Taylor Creek, twenty miles at the uppermost end of the lake. The steamer also towed up the scow Lillie Van, which was already fitted up with rooms, stove, and cooking outfit. This scow we hauled into the stream: it was to be our home while seining in the lake at the mouth of the creek. The seine was hauled three times a night: once just after dark, again about midnight, and once again before daylight. Some of the nights were so cold that the seine would freeze stiff five minutes after it was hauled out of the water. A bonfire burned while hauling the seine, casting its light over the water; the boatmen could thus see what ground to go over in paying out the seine and rowing in.

They would catch at one haul from five to ten, fifteen, or twenty trout, a few times more and sometimes not any; and many nights the seine could not be hauled on account of the rough sea. A great many Suckers were caught, sometimes as many as three hundred pounds weight at a haul. Some Whitefish were also drawn in. The Suckers were so plump that it was thought they must be full of trout spawn; twelve were opened and not an egg was in their stomachs; but the Whitefish, although small, were full of trout eggs.

The seining continued here some time, till no more trout could be caught. Mr. Burton and I went up the creek to the dam, but we did not see half a dozen trout.

The trout we caught were nearly all ripe; only about seven hundred thousand trout eggs were got at this place. Mr. Burton and Mr. Sam Nichols, who had fished in the lake many years, had prophesied that we would get here all the spawn we wanted.

The seine was drawn through the spring and summer at Meek's Bay, Blackwood Creek, and at the Incline, in Nevada. Traps were put in at Meek's, Phipps', and Blackwood Creeks. The creeks were so high, especially on a hot day when the sun would melt the tremendous snows of the past winter which fell on the headwaters in the Sierra Nevada Mountains. The streams would rise in a tumultuous volume of icy, roily water, which made it very difficult to put in the traps; and after a trap had been put in Blackwood Creek, the water rose two feet over all, tearing the trap out. The trap was put in again, but it was a trying work for the boys: Hunt, Will and Joe Shebley, who, after working in that icy water all day, slept on the banks of the creek in their wet clothes. Fishing was continued up to about the last of July, when the traps were all taken out.

There is usually a large run of trout up Blackwood Creek in March. Some time after we got up there a gill net was set in the current outside the mouth of Blackwood Creek, and nineteen fish were caught, weighing over two hundred pounds—one weighing a little over sixteen pounds. These were towed behind a rowboat, tandem fashion, for about five miles, by putting a line through the sides of their mouths and fastening it to a toggle of wood; these fish pulled back with the strength of a donkey; they were not ripe, and were put in the settling tank. On the following day, when Will was away on the steamer to Taylor Creek for spawn, six of these large fish were stolen.

The gill net was set every night afterwards for awhile, but the run was over and only a few more were caught. Some of the fish were spawned, and turned out about five thousand of fine looking eggs each.

The past winter was the hardest ever known here, and the snows the deepest. Those who lived at Tahoe said that it snowed almost continuously all the winter. The streams have been booming with icy water all the summer. For some cause but very few fish run up the streams. The fishermen said that the season was a month late, and that the fish would run up by and by; but it was not to be. They all said that the fish must have spawned in the lake. Lake Tahoe was as low as ever was known last fall, and since then it has risen about six feet, being about as high as ever was known; it has also been unusually rough this summer.

A new wharf has been built near the hatchery; a second-hand boat has been bought, and also a scow for seining and for shipping cans of fish. A great many tourists have visited the hatchery, and expressed their admiration of what they see outside of the hatchery as well as inside.

BLACK BASS, 1890.

About August first Will Shebley left the Tahoe Hatchery to go to San Francisco to begin shipping Black bass, leaving Mr. Hunt, who has had charge of the Tahoe Hatchery, with Joe Shebley to distribute the trout now on hand there. After the Tahoe Hatchery is closed for the season, Mr. Hunt will go below and help distribute the Black bass and trout from the Sisson Hatchery. Mr. Richardson will ship trout till the salmon hatching season opens, in the last of September, when he will be stationed at the Sisson Hatchery. The Black bass which we are catching now from San Andres reservoir are from six to nine inches long; these will probably spawn next spring. Seventy-five to one hundred of this size is all one man can conveniently and safely handle on a long journey.

This year, 1890, shipments have been made as follows: One to the Del Monte reservoirs, at Monterey, for the railroad company; one to the Blue Lakes, in Lake County; one to Clear Lake (two shipments were made to this large lake last year); one to the Pajaro River, near Sargent's Station; and one to a lake near San Luis Obispo.

Black bass distribution will continue this fall till as late as possible.

RAINBOW TROUT AT SHOVEL CREEK HATCHERY, 1890.

Trapping in Shovel Creek continued till about the first of July. The water was unusually high, on account of the deep snows on the mountains. About one million six hundred thousand eggs of the Rainbow trout were taken and eyed there; of these, one hundred and thirty thousand were hatched out and distributed in Shovel Creek—this was to give back the seed for the future from the harvest of eggs which we had gathered there.

One hundred thousand eggs were shipped to the North Pacific Game and Fish Club, and were hatched out by Mr. A. V. La Motte, at his hatchery in Glen Ellen; and which, he writes me, were distributed in Sonoma and Robinson Creeks, in Sonoma County and Mendocino County, respectively. This club, by permission of your honorable Board, trapped Sonoma Creek last winter for spawning trout, and Mr. La Motte reports that fifteen thousand native trout were restored to that stream.

One hundred and fifty thousand eggs were shipped to Mr. Alex. Badlam and hatched out in his trout hatchery at Arcadia, near Mount St. Helena. These were—part of them—for his ponds, and the rest, Mr. Badlam writes me, were distributed in streams, as follows: In Sulphur Creek, near the Geysers, in Sonoma County; in Lokonoma Creek, Anderson's Creek, Grizzly Creek, and Bradford's Creek, in Lake County; in Bear Creek, near Arcadia, and Troutdale Creek, Napa County. Mr. Badlam trapped Bear Creek last winter for spawning trout (with permission of your honorable Board), and reports that he restored to that stream fifteen thousand native trout as the result.

Fifty thousand eggs were shipped to Mr. Knowles, who has a hatchery near Alma; these were hatched out all right, but by some mishap they did not do well. I shipped a second fifty thousand to him, with which he had good success. These were distributed: about twenty thousand in Bear Creek and Deer Creek, branches of the San Lorenzo Creek, in Santa Cruz County; the balance was divided between his own ponds and a branch of the Los Gatos Creek.

Fifty thousand eggs were shipped to the hatchery at the Hotel Del Monte; this lot did not do well through want of experience and the high temperature of the water, owing to its being so low in the reservoir from the main pipe having washed out last winter. I shipped a second fifty thousand eggs there; they hatched out, and, with more experience on the part of the attendants, did well. These have been distributed in their reservoir and in the Carmelo River.

The hatching out of these eggs sent to private hatcheries, their expressage from Shovel Creek, and the distribution of the young trout, has been done free of expense to the Commission. This saved to the Commission the cost of distribution of the young fish from the Sisson Hatchery, which would have been a large item, and was also the means of stocking many streams which would otherwise have been impossible this year.

I visited the Del Monte Hatchery several times, Mr. Knowles' hatchery twice, and Mr. Alex. Badlam's hatchery once, to give instructions.

Hon. A. R. Williams, Ramen Wilson, and a number of other gentlemen have made arrangements to build a trout hatchery at Webber Lake for the purpose of maintaining the supply of trout in that and Independence Lakes and in the streams in their vicinity.

The thanks of the Commission and of the people of the State are due these gentlemen for their unselfish interest and laudable efforts in behalf of the fishery interests of the State.

I am satisfied that the efforts of these gentlemen will meet with every success, and that they will at all times receive the encouragement and support of the Commission.

Fifty thousand of these Rainbow trout eggs were shipped to the State Hatchery, at Tahoe, on application of Commodore Todman; these were hatched out and planted in the Truckee River below the dam at the outlet of Lake Tahoe.

The balance of the eggs, about one million, was shipped to the Sisson Hatchery; these eggs and the young fish did finely in the cold water at Sisson. They have been fed in the troughs for several months awaiting shipment.

After the eggs were all taken at Shovel Creek, Mr. Richardson began shipping these fish from Sisson for distribution, taking ten cans at a trip, and about three thousand fish in a can, or thirty thousand to each trip, which are as many as it is safe to handle on a trip in hot midsummer, the round journey averaging about eight hundred miles, and taking about three days' time.

A trip with this number has been made to Lagunitas Lake, Marin County, and to about five miles down the Lagunitas Creek, below the dam; also, to the following places: to Crystal Springs Reservoir, San Mateo County; to Alminitos Creek, near the New Almaden Mines; the Guadaloupe Creek, Saratoga Creek, and to Smith Creek, near Mount Hamilton, a branch of the Calaveras Creek; to the Arroyo Mocho, twelve miles south of Livermore, and the Calaveras and the Alameda Creeks, near Sunol; to Monterey County, for branches of the Salinas River, near Salinas and Soledad; to Bowlder Creek and other branches of the San Lorenzo Creek, in Santa Cruz County; to Almao for the Los Gatos Creek, in Santa Clara County; to the San Gregorio Creek, over the mountains from Redwood City; to Gilroy, for the Uvas Creek; to the Lagunitas or Paper Mill Creek; to Napa City, for branches of the Napa Creek; and to a small creek, near Santa Rosa, a branch of the Russian River.

Arrangements have been made to ship these trout to Dr. Smith, of Placerville, for the American River; also, to Judge McD. R. Venable, in San Luis Obispo County, for streams there; to the Sonoma Creek, Cache Creek, in Yolo County, and other places. We shall continue to ship these trout until their trough room will be needed for the salmon at Sisson, or until we are admonished to quit shipping to save funds for our winter and spring work. These which are not shipped to the central and southern parts of the State, will be planted in the Sacramento River. There have been already planted during August, 1890, in branches of the Sacramento, one hundred and fifteen thousand, distributed thus: West Fork, Sulloway's Creek, Cold Creek, School House Spring Creek, and near Peter Klink's place. The balance for the Sacramento will be distributed below the eighteenth crossing.

During both seasons of our work at Lake Tahoe, in 1889 and 1890, Commodore Todman has been exceedingly generous in his aid to advance the work of the Fish Commission by giving at all times free transportation on the steamer Tod Goodwin to all parts of the lake, shipping our racks for traps, fish cars, seines, towing the boats to the different streams, shipping our supplies, and also giving almost daily passage for the men in their traveling to the creeks where the traps were, for eggs, and in shipping the trout for distribution.

Captain Wherman and his men on the Tod Goodwin have also been very kind and willing in helping us, by doing many errands at distant points of the lake. Mr. Lawrence, of the Tallac House, and Captain Holt, also generously gave us free passage on the steamer Tallac. The citizens around the lake gave us many accommodations.

It would have been impossible for the Department of Hatcheries and the Restoration of Fishes to have done with its small funds the amount of work it has accomplished without the generous help which the Southern Pacific Railroad Company has extended in giving an annual free pass to the Superintendent to all parts of our State in his frequent trips to the hatcheries from San Francisco; also, in giving free passage in the baggage car for the salmon and trout eggs and all the cans of trout in the many shipments for distribution from the Sisson Hatchery, in the shipments of Black bass, and free passage for the attendants with the fish. The railroad people were very kind also in giving us the use of a handcar and right of way on their road in shipping the young salmon down the Sacramento for distribution. I would like to give an instance in which the railroad people have shown their kindness to the Fish Commission, and at the same time show why but few salmon have been up the Sacramento to spawn during the fall run for a long while past.

I was told by different parties that at a point on the Sacramento River, near the railroad tunnel No. 3, there was a horseshoe bend in the river; through the neck of this bend a mining company, years ago, had made a tunnel to drain the river in the dry season, so that they could mine the bed of the river around that bend. In August and September, when the salmon make their great migrations to their spawning beds, it was noticed that for years past but very few salmon made their appearance in the Sacramento River above the bend, while in early times the salmon went up in thousands.

In August and September the river is very low, and most of the water went through this tunnel, leaving so little water in Horseshoe Bend that it was almost impossible for the salmon to make their way up, while they congregated in thousands at the lower end of this tunnel, where the volume of water came through with such force, and made such a jump off into the river below, that the fish could not get up. Here the Indians, and also white men, would assemble, and while the salmon were using up their strength in continually making ineffectual efforts to leap up into the tunnel, they would destroy them with grab hooks and nets. This point is but a little way above where the Pitt River joins the Little Sacramento.

I determined to stop, if I could, this destruction of salmon and give them a chance to get up on their spawning grounds and deposit their eggs. I went down to this tunnel and made an examination, and saw at a glance that the railroad people—with their ties and old bridge timbers, with their handcars to carry them to the tunnel, and the crews of road repairers to do the work of putting in the timbers to face the tunnel, and blasting down the overhanging bank to fill up the open cut—could do the work much cheaper than I could. So I called at Fourth and Townsend Streets and told my story to the railroad people, showing the importance of this tunnel being closed up, that the salmon now being stopped there might not be hindered in making their way up the river to their spawning grounds; and asked them if they would not, as a great favor, have this job done by their men and send in their bill of expenses to the Fish Commission. They readily assented to have the work done, and, at the same time, said that if it did not cost too much, no charges would be made. In a short time they had the tunnel closed (1889), but, owing to the great pressure of the waters in the floods of the present year, 1890, the dam at the tunnel was torn out.

During the past summer it has been closed again, and the salmon will now have an unobstructed highway up the river.

The Fish Commission is also under obligations to the San Francisco and North Pacific Railway for free transportation, and also to the North Pacific Coast Railroad, both giving the use of their baggage cars and free passes for the attendants over their lines in shipping trout and Black bass for distribution.

I wish here also to acknowledge the many courtesies and aid extended to the Fish Commission by the many applicants for trout and Black bass, who have furnished teams to transport the fish and attendants from the railway station to the streams for planting; also, to Mr. J. H. Sisson for the use of the ground and the water for the Sisson Hatchery, and to the Edson Brothers for the use of the ground for the Shovel Creek Hatchery on their hotel grounds, and the privilege of trapping Shovel Creek for trout.

HAT CREEK.

I visited Hat Creek to see what advantages the State Hatchery there offered for hatching salmon. The hatchery at Hat Creek is a large building one hundred feet by forty-six feet, with sixty-four troughs sixteen feet long and twelve inches wide. The building has settled at its upper end owing to poor underpinning; the troughs have the grade the wrong way. The dependence for water is from a ditch owned by private parties, who use it for running machinery. The water comes through the ditch from up Hat Creek, and the ditch is dug through a formation of infusorial earth which is disintegrated by frost, making it very loose and friable; it crumbled into the water in the ditch, and was held in suspension in such quantities that it covered up the eggs in the hatching troughs.

The proper way is for the Commission to have entire control of the water for the hatchery. Copartnership in a ditch causes trouble, and the water is liable to be turned off entirely from the hatchery, which would cause, if it lasted for a few hours, the entire loss of all the fish and eggs. The water could be brought into the hatchery by an undercurrent wheel built in Hat Creek, near the upper end of the hatchery, which would give a large quantity of clear, cold water, and would, if built strongly, give a certainty to the continuousness of the supply; for Hat Creek never rises, as I have been informed, over eight inches above low-water mark. Hat Creek has a large volume of water at all seasons.

I think the more suitable place for the hatchery would be at the confluence of Hat Creek with Pitt River, on a point of land about two miles below the present site of the hatchery, where a large spring flows of clear, cold water; and as it is at the lower end of a fall or riffle in Hat Creek, a ditch of short length could be cheaply made to bring water for ponds. Opposite, and close at hand, is a seining place in Pitt River, and at this point, also, in Hat Creek, a trap could be built, as well as in Pitt River, to trap salmon and trout for spawners. The hatchery and spawning traps would be close together, which is of great importance for accommodation and security. (Fourteen years ago, when the old Board of Fish Commissioners gave me instructions to survey the Pitt River Falls, I selected this place as the most suitable for a salmon hatchery, if one ever should be built on Pitt River.)

There are not many salmon running up Pitt River, it is said, but if these were caught and spawned, and the numbers supplemented by eyed eggs sent from the United States Hatchery on the McCloud River, a plant of two millions could thus easily be deposited in Pitt River and Hat Creek, which would be good nursery grounds for these fine fish to increase their numbers on the fishing grounds of the lower Sacramento River.

THE CLOSE SEASON FOR SALMON.

To prevent any depletion of our rivers, while the present great draft upon their fish supply is going on, to meet the demands of the canneries and the local markets, it is necessary that a sufficiently large number of young salmon should be hatched out naturally as well as artificially. It will be impossible to keep up the supply of salmon from artificial hatching alone for this reason, that the nursery grounds, which are accessible to distribution of the young salmon that are hatched artificially, are not extensive enough to meet and fully supply this great demand. We must have the aid of the salmon of the spring run to supplement our efforts, by stocking the highest mountain streams. The young salmon should be placed upon a great extent of nursery grounds for food and protection, to keep up the supply of mature salmon to return from their stall feeding in the ocean.

In order that this may be successfully accomplished, it is essential that the close season for salmon should be sufficiently long to give a free highway to enough breeders to ascend to the extreme headwaters of the salmon-breeding rivers to deposit their spawn over a large extent of nursery grounds beyond where teams can go to distribute cheaply the young fish from artificial hatching.

There are two great runs of salmon up the Sacramento River: one in March, April, and May, and another in August and September; but salmon are caught in considerable numbers during every month in the year.

RUN OF MARCH, APRIL, AND MAY.

It is very essential that a close season of two or three weeks in the month of April be enforced, in order to give a clear road for the passage of a part of the cream of the great run of the salmon in March, April, and May. It is the salmon from this run which reach the upper waters of our rivers, where they are almost inaccessible to man. Especially is this the case on the McCloud River. Above the United States Salmon Hatchery, which is about two miles from the confluence of the McCloud with the Pitt River, there are only four white men and but few Indians; and above the last white man on the river, eight miles beyond the United States Hatchery, for some sixty miles, till you reach "Horseshoe Bend," there is scarcely a soul to be found, when the spring run of salmon go up, to "molest or make them afraid" when passing through this long reach of the best salmon-breeding river in the world.

It is a fact well known to fish culturists that the winter and spring run of salmon, during the high, cold waters, go to the extreme headwaters of the rivers if no obstructions prevent, into the highest mountains.

They are in the very best condition when they start on their long journeys. Nature has implanted in them the instinct to begin their journey while the spawn is yet small, that it may not become full grown and ripe for depositing until they reach their far-distant spawning grounds.

As they eat nothing while on their journey up the rivers, and with their fighting and exertions to overcome this distance, a great deal of the way being through a swift, racing current, and also with a constant draft upon their own vitality to mature their spawn, they become much exhausted and emaciated.

These fish cannot be used for spawning artificially, for at this season the waters are too high to catch them, and they are too unripe when they pass the United States Hatchery on the McCloud River to catch and impound them; in the attempt to keep them till they become ripe they would all die before they were ready to spawn. They will kill themselves if kept long in confinement, in their frantic efforts to get free to ascend to their spawning grounds.

THE CLOSE SEASON FOR THE AUGUST AND SEPTEMBER RUN.

The spawning time at the Government Hatchery on the McCloud River for the great run of salmon in the late summer and fall is principally during the month of September; it usually opens about the twenty-eighth of August and continues until the latter part of September.

The vital points of the question in considering the time for the close season are: At what time should the close season begin at the fishing grounds on the lower Sacramento River, and how long should it last in order that enough breeding salmon from the great run during the months of August and September may reach the United States Hatchery on the McCloud River, during the month of September, to furnish sufficient eggs for the artificial hatching of young fish for distribution on the nursery grounds to maintain the supply of mature salmon for food, which the rivers for nursery grounds and the ocean for feed till the salmon are matured, are capable of producing?

Ten years ago, during the administration of B. B. Redding, S. R. Throckmorton, and J. D. Farwell as Fish Commissioners, as many as fourteen millions of salmon eggs were taken during the month of September from the fall run of salmon.

The close season at that time was during the month of August.

The close season is now, and has been for some years since, during the month of September.

The Government Hatchery, on the McCloud River, renewed its operations in 1888. The number of eggs taken in September, 1888, was only about one million five hundred thousand; and in 1889, only about one million one hundred thousand eggs: or, averaging for the two years, less than one tenth as many eggs as were taken ten years ago, when the close season was during the month of August. This is a loss of 90 per cent.

For what cause, or by whose agency the close season was changed from the month of August to the month of September, I do not know. It was certainly a very disastrous change, if the interests of the salmon were considered.

During the last Legislature, in 1888, a bill was introduced by some one—from Solano County, I believe—to change the present close season for salmon from the month of September to the month of October.

If this bill had become a law, the close season would have been pushed entirely beyond the season of the great run of salmon. "Give them an inch and they will take an ell," if they can get it.

It is of the utmost importance that the close season should be placed back again to the month of August. If more salmon do not reach the McCloud River during the month of September than have arrived there during the past two years, serious consequences will happen to the salmon industry of California.

By changing the close season for salmon back again to the month of August, it can easily be determined if the run of salmon has lessened during the past ten years.

If as many salmon do not arrive there during August and September as did ten years ago, or if an insufficient number got up during that period from which to secure the number of eggs necessary for artificial reproduction, then it will be imperative to include part or the whole month of September in the close season, in addition to the month of August.

I see no reason why this change should have been made in the close season, unless it may have been to accommodate the canneries and fishermen on the lower Sacramento in securing greater catches of salmon.

If there is any accommodation to be done in the matter, it should be towards the salmon which are trying their best to reproduce themselves in the effort that their kind may not be diminished, and not to those who are doing their best to destroy the salmon for the future that they may fill their pockets to-day, and "kill the goose that lays the golden egg."

Can it be possible that the people of this State will allow a great resource of food supply, which Nature has planted in our rivers, to be endangered by the remorseless destruction going on in the effort to catch every salmon that attempts to go up to the spawning grounds?

The following valuable communication has been received from Mr. Geo. B. Williams, Jr., and I take great pleasure in submitting it to the consideration of your honorable Board, as it so strongly represents the facts of the case:

BAIRD, CAL., July 8, 1890.

Mr. J. G. WOODBURY, *San Francisco:*

DEAR MR. WOODBURY: Yours of the fifth at hand. Two years of experience in charge of this station on the McCloud has convinced me that unless some action is taken by the Legislature and those interested in the propagation of salmon as a food fish, to include the month of August as well as that of September in the close season, not many years will elapse when this valuable food fish will become almost extinct.

On account of the high water we are liable to have at this point during the spring and late fall runs, it is impracticable to secure and spawn by artificial methods the parent fish; but the August run comes at a time when it can be handled successfully. In order to allow this run to reach the headwaters of the Sacramento River and its tributaries, the months of August and September should be reserved to allow a free passage of salmon.

I draw my conclusions from the fact that in previous years, when there was no fishing with seines in the Sacramento to speak of, thousands of salmon collected here during the latter part of August and during the month of September, and we found no difficulty in securing all the eggs we could handle, fourteen million ova having been taken in one season. From the August run in 1888 but one million five hundred and sixty-eight thousand six hundred eggs were secured, and in 1889 one million one hundred and five thousand were taken. In 1888 the season's take was increased to five million five hundred and four thousand six hundred, by securing ova from the late run in October and November. But this was something unusual, and could not have been accomplished had it not been that the rains did not set in until December of that year. An attempt was made in 1889 to take the late run, but rains in October caused the McCloud to become very high, and racks and dams were washed out, allowing the parent fish to ascend the river and small creeks above the station.

It is very hard to decide how long it takes the salmon to reach their spawning grounds after they leave the seining grounds of the lower Sacramento, but as near as we can tell, from two to three weeks.

As you know, the work done at this station is almost entirely for the State. It seems as if it should be the aim of the people to do all in their power to aid the United States Fish Commission to accomplish its object by making laws that will protect this valuable food fish.

Much more could be said regarding the tremendous decrease in late years of the salmon, but I think I have advanced sufficient reasons to show that a longer close season is necessary to make a success of our work. It is a question that should be seriously considered and acted upon at once.

Yours truly,

(Signed:) GEO. B. WILLIAMS, Jr.,
Superintendent of Station.

STRIPED BASS.

There were brought to this coast in 1874 some one hundred and fifty Striped bass, about one and one half inches in length. From these quite a number of mature fish were caught in years afterwards, but it was not certain that they had reproduced themselves, and it was thought best to have another shipment of these fish brought out to this coast, to make it as sure as possible that these excellent fish should become familiar in our waters.

By instructions of the Board of Fish Commissioners, B. B. Redding, S. R. Throckmorton, and J. D. Farwell, in 1882 I brought out from the Shrewsbury River at Red Bank, New Jersey, just above Monmouth Park, a shipment of Striped bass, running from five to nine inches in length, and planted them in Suisun Bay, at Army Point. Quite a number of these have been caught from year to year, increasing in weight every year. Last year several were caught weighing over twenty pounds, and during the past winter one was caught weighing thirty-five pounds.

I have been watching for the young fish, the progeny of those brought out in 1882, and during the past spring, on my return from a trip to Tahoe Hatchery, I heard that they were being caught by the thousands and offered for sale in the market. I hurriedly went up to the market to see if it were true. I found there a lot still unsold, averaging from one half to three quarters of a pound in weight. I was delighted to see them, knowing that those brought out from New Jersey must have kept together in the muddy waters of our bay till they matured and spawned, and their young had been successfully reared.

But knowing that the young Striped bass run in schools, I became alarmed lest the many Chinese nets in our bay and the lower Sacramento and San Joaquin Rivers would soon destroy the greater part of them, which would be a great pity, as they had cost so much money, trouble, and time in waiting for them to reproduce themselves. And if these young fishes could remain unmolested for a few years longer, till they themselves had spawned, our bays would be full of these splendid fishes. Certainly this would be a great acquisition to the whole Pacific Coast.

I immediately visited the newspapers, and they kindly published a notice of the arrival of the numerous strangers, of their great importance, and the danger of their destruction if they were not protected.

Your honorable Board petitioned the Board of Supervisors to pass an ordinance to prohibit catching them under eight pounds in weight. This they quickly did. A similar petition it would be advisable to present to the Boards of Supervisors of Marin, Sonoma, Solano, Contra Costa, Alameda, San Joaquin, and Sacramento Counties. The young bass will most certainly visit the waters of all these counties, and their protection for a few years is of vital importance.

I have since learned from the market men that from three to four thousand of these fish were sold in the market before the ordinance was passed, and that it has since been in the newspapers that these fish have been caught and sold in other counties around our bay.

The arrival of so many young of this fish at one time in our markets, shows conclusively that the Striped bass have successfully reproduced themselves in our waters. Our anglers may anticipate some grand sport in a few years.

I am happy to give the people of California some desirable information about this useful fish, and take the opportunity of appending to my report a valuable paper taken from "The Fisheries and Fishing Industries of the United States," by George Brown Goode.

NECESSITY FOR A TROUT HATCHERY NEAR SAN FRANCISCO AS A DISTRIBUTING POINT.

California is a large State in territorial area, approximating to three times the size of the State of New York.

The headwaters (the breeding places for trout and salmon) of most of the large streams in our State are far away from the railroads, and are also in high altitudes. To reach these is, in most instances, a weary road to travel by stage coach and teams, and in some cases by horseback only, following Indian trails through almost impassable cañons and mountain gorges

The Sisson Hatchery, which is at present the distributing point for the Rainbow trout, is about seven hundred miles from the southern border of the State, and applications for trout come in from Siskiyou to San Diego Counties.

To distribute fish into these streams over such a vast territory is very expensive, and the cost is much increased by the many difficulties in getting to their headwaters with teams heavily loaded with ice and cans of water, over the long, hot valleys, and up steep mountain roads.

It is also unsafe to transport young fish in large numbers over such long distances.

To ship half a million of eyed eggs is comparatively inexpensive to what it is to ship the same number of young fish. Thirty thousand young trout in eight to ten cans of water is as much as it is safe for one man to carry on a long journey. This means half a ton of water and hundreds of pounds of ice.

Express charges for this great weight are heavy; the cost of the ice, railroad fares to and fro, teams to transport the fish from the railroad to the streams (sometimes for sixty miles to their headwaters), hotel expenses, and telegraphic charges rapidly eat up our funds.

Two men are compelled to go on long journeys to care for the fish, as the water in the cans has to be almost continuously aerated night and day to give the fish fresh air to breathe, and the water in the cans requires occasional changing.

A trip with trout from Sisson to the southern part of the State consumes nearly one week's time, which is very dangerous to the safety of the young trout, and limits the number of trout which can be distributed. To make these journeys shorter and less expensive, with saving of time, and with more certainty that less fish will be lost in their transportation, it is essential that a string of hatcheries should be established as is done in other States.

We have already built and equipped two extensive hatcheries: one at Lake Tahoe as a point for distribution for the mountain region and the eastern slope of the Sierras; and a large hatchery at Sisson, which was built for the purpose of stocking the Sacramento River with salmon. This can be used as a distributing point for the northern part of the State for trout also; and a small hatchery on Shovel Creek, which is for eyeing the eggs of trout to be shipped to other hatcheries as distributing points.

Now, it is very essential that a hatchery with nursery troughs (space sufficient to accommodate one million of young trout till they begin to feed, or till they are old enough to be distributed in the streams) should be built during the coming winter in or near San Francisco, as a distributing point for the waters in Central California, to which the eyed eggs can be sent from Shovel Creek or some other hatchery.

A plain hatchery for this purpose, well equipped, with quarters for the men, would probably cost from $1,000 to $1,200.

The demand for trout will be the greatest from a hatchery here to keep up the supply in the many streams in this part of the State, to meet the growing wants of the many anglers in the counties surrounding the bay of San Francisco.

This place is also the center from which radiates all the many routes of travel by which the trout can be conveniently shipped to all parts of the State without delay.

After full consideration of these matters by your honorable Board, if I have presented the subject in a proper light to convince you of its importance, I would suggest that a petition be presented to the incoming Legislature in the first days of its session to make an appropriation of $1,000 to $1,200 for a new hatchery and its equipment and quarters for the attendants, the money to be immediately available, so that work can begin in time to have it finished to receive the first trout eggs in the early spring of 1891.

APPROPRIATIONS FOR THE SUPPORT OF HATCHERIES AND RESTORATION OF FISHES.

As the field of fish culture and propagation is continually increasing, the appropriation for this department must also increase with its development. The appropriations, owing to the immense area of California, should at least approximate those of Eastern States (which are devoted almost entirely to hatcheries and the restoration of fishes). The State of New York, which is of one third less area, makes an annual appropriation of from $30,000 to $35,000 to enable its Fish Commission to carry out its work. This department is being continually hampered by want of funds, and is compelled to forego the necessity of making constant improvements. Efficiency, thorough and satisfactory, cannot be had without incurring expenses far above the present limited appropriation in the department embracing Hatcheries and Restoration of Fishes.

It is doubtful economy that hinders the cheapening of food for the people.

It seems absurd to appropriate so small a fund as $5,000 to foster and maintain the fish industries of this State. A resource furnishing a staple article of food for the people—a cheap and plentiful supply of wholesome food—is of immense importance. The waters of California are almost unlimited in their capacity to produce fish food, but wanton destruction of fishes when they congregate at certain seasons of the year for breeding purposes, and the increasing demand on them to supply an increasing population with food, will soon largely diminish their numbers unless assistance is rendered by artificial reproduction on a greater scale than is being done at present.

When live stock is owned by private parties it is to their individual interest that the best care be taken of it to the end that it may make the most remunerative returns. But the fish which the waters of our State produce are the common property of the whole people, and it is not the duty of any one individual to see that the fish interests are cherished.

AN ANNUAL APPROPRIATION OF TWELVE THOUSAND DOLLARS NECESSARY.

It follows that it is the duty of the Legislature to appropriate adequate funds to meet the expenses incurred in carrying out the work necessary to such an important trust.

This work embraces the artificial reproduction and distribution of young salmon upon their nursery grounds to keep up the supply to meet the immense draft upon their numbers as they annually migrate as mature salmon from the ocean to their spawning grounds, by the fishermen's many miles of network and seines, catching them to supply canners and the local markets.

If this work is not kept up from year to year, it is certain that their number will be diminished, and in time salmon will become as great a rarity in California as they are to-day in New England.

The artificial reproduction and distribution of trout over this State to satisfy the increasing number of applications for these fishes to supply the depleted streams which our growing population in their search for health and recreation exhaust, it is far beyond the unaided powers of trout to keep the streams well stocked; and as far as the present appropriation for this costly work goes, it is only a make-believe towards accomplishing what the real work should.

It would be most desirable to continue the purchase of the eggs of the Eastern Brook trout—that pride of the trans-mountain angler—for their introduction into the headwaters of all our high mountain streams, where it has been demonstrated they have done well in the past, and it is but reasonable to suppose that as they become acclimated they will gradually descend the rivers and spread themselves over the whole State.

The Black bass is such a desirable fish that, as we already have them, it would be a public benefit to systematically distribute them into all the suitable waters of the State. When once planted they become permanent "settlers," no restocking is necessary, and it would be well to do this work quickly.

I would recommend the introduction of the eel, which is highly esteemed in the East and in Europe; in fact, it is considered a luxury, and is preferred by many to the trout. The flesh of the eel salted, smoked, and pickled, forms quite an article of trade, and will in time afford a large addition to the food for the people.

Many have asked for the introduction of the Big-mouthed Black bass from the Southern States for planting in our warmer waters; also, the big catfish of Texas, which occasionally weighs three hundred pounds. It is said that it would be very desirable for the Sacramento and San Joaquin Rivers.

A part of the fund should be expended for the scientific investigation of the economic fishes of our State, and experimenting in artificial reproduction of others fishes, among them the sturgeon, which valuable food fish is becoming notably scarce.

For all of the foregoing, which is expensive field work, the present appropriation of $5,000 is ridiculously insufficient, and it is needful that $12,000 should be annually appropriated for the sole and exclusive use of this department.

Therefore, I would suggest to your honorable Board that you would petition the Legislature for an annual appropriation of $12,000 for the Hatcheries and Restoration of Fishes.

SCREENS FOR DITCHES.

Most ditches take their supply of water from the streams above the valleys, from the lower foothills to far into the high mountains.

Our mountain streams are good spawning grounds for trout and salmon.

The young trout, as soon as able to swim, leave their hidden recesses in the gravel and seek the shallow water near the bank or shore of the streams where the water is less swift. Here they are better able to stem the current, and are also comparatively safe from the raids of larger fish which live in the deeper water, and are cautious about venturing into the shallow water.

Ditches, of course, take their supply from the shores of these streams. The current at the inlet of these ditches is strong, and draws the little fellows down with the water farther and farther. The current within the ditch is so strong that they cannot get back, hardly, even if the instinct of fear impelled them to do so.

But they go with the current willingly. Mother Nature has not taught them that these side issues from their native brooks lead to their destruction, by distributing them with the water to nourish the roots of alfalfa and timothy grasses, or through the great fields of the raisin grape or wine vineyards and orange orchards; nor by being dashed over the rocks through nozzles of miners' pipes, nor by being ground up into mince meat by the turbine wheels of sawmills and papermills.

These thousands of ditches tapping the mountain streams the whole length of our State, from Oregon to Arizona, destroy ten times more fishes, especially the trout and salmon, than is done by all other means of illegal destruction of fishes. The numbers of trout destroyed through the agency of ditches will run up into millions every year.

This great destruction of fishes is self-evident to every man who taps a trout stream for irrigating purposes, unless the process has been going on so long that the stream has already become barren of fishes.

I have already cited an instance in this report of the great destruction of trout in Siskiyou County by a ditch from Shasta River, which was told to me by the owner of the ditch.* I have known of what I write by observation in traveling over this State during the past twenty years.

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*Refer to trip to look up a trout hatchery in 1889.

Hundreds of men have told me the same story, and angrily denounced such wanton destruction of trout, saying that in a few years, unless there was a stop put to it, there would be but few to destroy. Those who use the waters from these ditches admit the facts. I do not believe there is a man in the State who knows anything practically about the use of ditch water but who will admit what I have stated about the great destruction of trout is substantially true. I will instance a case which happened last year not far from the hatchery at Sisson.

A lot of young salmon had been distributed in Big Spring Creek. At that time we were not aware that there was a ditch taking water from this creek, but it happened there was one whose inlet was from the opposite bank from the road, hidden from view by a thick growth of alders.

Some time after the salmon had been planted, at a considerable distance above this ditch, its owners had occasion to shut the water off. After the water had drained away they saw so many dead salmon, that word was sent to the men at the hatchery who went up to investigate, and they estimated that about seven thousand young salmon had perished. What is the use of stocking our streams with fish to have them killed off by wholesale in this manner?

It is well known that in early times all the mountain streams through the mining counties were bountifully stocked with trout, and where there are at the present time hundreds of ditches taking water from these streams for irrigating and mining purposes. All these streams have fine spawning grounds for trout for miles far above where the mining debris has been deposited, and even where it is almost impossible for an angler to go. And besides these counties are not thickly populated, and the streams cannot have been fished to excess. Yet the people in these mountain counties are asking for trout to restock their streams.

All these streams would be full of trout if it were not that they have been destroyed by the open ditches.

To stock these streams with trout, whose waters are taken out through ditches without screens at their inlets to protect the young fish from being drawn into them and destroyed, is a waste of time and money. It is as ineffectual as it would be to try to dip up water in a sieve.

If it is of material consequence to keep our mountain streams stocked with trout and salmon, then it is imperative that a law should be passed compelling the owners of all ditches, flumes, and pipes which take their supply of water from public streams, to maintain screens across their inlets of sufficient fineness to prevent young trout from finding their way through.

In regard to the size of the mesh, it is of the utmost importance that it should keep out the young trout, and yet let through enough water for the requirements of the ditch.

The mesh of the screen should not be larger than one fourth of an inch square.

To let in sufficient water with this size of mesh, and not require but little attention to keep off rubbish, the surface of the screen should be two or three times larger than the cross-section of the ditch.

The ditch or flume should be enlarged at its inlet or mouth by flaring its sides to accommodate this size of screen.

A good way to put in a screen which will prevent the young fish from being drawn against the wire, as well as the floating stuff in the stream, which would have a tendency to choke the screen, and, of course, let in less water, is to have the flaring end of the flume flush with the bank of the stream, and fitted with cleats to receive a light wooden frame.

To this frame should be fastened an oblong square basket made of the screen wire cloth. The depth of the basket should be a foot or so, according to the size of the ditch. The screen being in place, the depth of the basket would thus project into the stream, and have the two ends, one side, and the bottom of the basket as a screen surface.

The upper end of the basket would, of course, be more or less clogged up with floating stuff, but the under side and the lower end would be almost entirely free, while the bottom of the basket, or outer surface, which should be nearly parallel with the current of the stream, would be kept comparatively free from floating stuff by the current itself.

This basket screen, being loosely fitted between the cleats, could be easily taken out, and with a few splashes in the stream cleared of all rubbish.

A coarse rack of slats outside of the screen would keep off any large floating substance, which might otherwise injure the basket, and with a boom fastened at the bank above the ditch, and swung diagonally part way across the stream and fastened in position, would ward off most of the floating debris.

Of course, if the main ditch at the stream has a screen, the smaller ditches taking water from the main ditch will require none.

Galvanized wire cloth of one quarter-inch mesh, strongly made, and soldered at each intersection of the wires, can be bought in San Francisco for 6 cents per square foot.

The cheapness of the wire will make the cost of a good sized screen but a small item. And with a little of our American ingenuity in constructing it, and an ardent desire for the safety of our trout, screens can be speedily placed at the inlet of all ditches.

Accompanying this report will be found a copy of the Screen Law of Wyoming, which Fish Commissioner Louis Miller kindly sent me.

The Striped Bass. Roccus Lineatus.

Geographical Distribution.—The Striped bass, as has already been stated, occurs in all the waters of our coast from latitude 50 degrees to latitude 30 degrees. In the North it is called the "Striped bass," in the South the "Rock-fish," or the "Rock." The neutral territory, where both these names are in use, appears to be New Jersey. The fishermen of the Delaware use the latter name; those of the seacoast the former. Large, sea-going individuals are sometimes known in New England by the names, "Green-head" and "Squid-hound." There is still some uncertainty regarding the southern limits of the distribution of this species. In the Saint John's River, Florida, they are very unusual. Though familiar in the fisheries of that region since 1873, I have only known of the capture of two individuals. Mr. Stearns has obtained one or two specimens in the Gulf of Mexico, and gives an account of the degree of their abundance in those waters. He writes: "They are occasionally caught on the northern shores of the Gulf, and are, evidently, more common about the mouths of the Mississippi River than elsewhere. Since they are taken in this region only in seines, and in shallow water, their abundance cannot be correctly determined. The earliest I have been able to obtain of the capture of Striped bass in Pensacola Bay, is that of Captain John Washington, of Mystic, Connecticut, who states that in 1850, while seine fishing from the smack "Francis Parkes," he surrounded with his seine a large school of fish which were quite unmanageable. A few of them were saved, and proved to be large Striped bass, weighing from fifteen to forty pounds. At long intervals since, solitary individuals have been taken at various points on the coast. At New Orleans it is found in the market quite often. An eighteen-pound specimen was sold there in March, 1880."

In Hallock's "Sportsmen's Gazetteer" the following statement occurs: "It is constantly seen in rivers of fresh water at great distances from the ocean, even as far up the Mississippi as St. Louis, and it is common in White River, Arkansas, and in all the rivers of the Southern States."

While there can be no question that straggling individuals of this species have been taken in the Gulf of Mexico, it seems probable that both Mr. Stearns and Mr. Hallock have been mistaken by the resemblance of this species to the Brassy bass (*Roccus interruptus*), which abounds throughout the lower Mississippi Valley.

Canadian authorities inform us that, though the bass still occur along the New Brunswick and Nova Scotia shores of the gulf, they are much less abundant and of smaller size than formerly. They have been known to ascend the St. Lawrence as far as Quebec, and Mr. Roosevelt has seen a specimen, a female fish, which was taken in the Niagara River near Lewiston. The bass is most abundant in the bays and inlets of Cape Hatteras, in the Chesapeake and Delaware Bay region; and in the protected waters of Long Island and southern New England. In winter they occur in considerable numbers in the Altamaha River, and are unusual in the markets of Charleston, South Carolina.

Habits.—The Striped bass is not migratory, being found along our coasts in winter as well as in summer, and in our markets in every month in the year. Great quantities are taken in winter in the rivers tributary to the Chesapeake, and in the rivers of New Brunswick quantities of them are speared through holes in the ice. During the past four years I have known of their capture in Long Island and Block Island Sounds, and in the Merrimac River in December, and in Martha's Vineyard Sound and in the lower part of the Hudson River in January. Though they appear to avoid a temperature higher than 65 or 70 degrees, they are not sensitive to cold, and there is good evidence that they frequently, when detained throughout the winter in shallow places, enter upon a state of torpidity.

Food.—They are very voracious feeders. Entering the rivers, they prey upon small fishes. They are particularly abundant at the time of the spring runs of the shad and herring, and at this season are particularly plump and well fed, doubtless owing to the ease with which they can obtain food. They also frequent the rocky shores of the bays and sounds at high tides, in search of crabs, shrimps, and squids; and they are said to feed upon clams and mussels, which they obtain by delving with their snouts.

Reproduction and Growth.—They spawn in the late spring and early summer, some of them in the rivers, others probably at sea, although this has not been definitely ascertained. The European bass are said to deposit their spawn near the mouth of the rivers in the summer months.

From North Carolina to New Jersey the spawning time appears to be in May; in New Brunswick in June. Dr. Blanding many years ago estimated the number of eggs at two million two hundred and forty-eight thousand. Their rate of growth is very rapid. Dr. C. C. Abbott, for five successive years, found in the Delaware River young an inch long in the second week in June. About the middle of October these had grown to the length of four and a half inches.

The young fish—five to nine inches in length—which are taken in such quantities in the Potomac in February and March, are supposed to be the young of the previous year. Captain Gavitt, of Westerly, Rhode Island, has caught bass in June that weighed from one half to one pound, put them in a pond, and taken them out in the following October, when they weighed six pounds. The average size of this fish probably does not exceed twenty pounds. In the Potomac, Hudson, and Connecticut Rivers the largest seldom exceed thirty or forty pounds, though in the Potomac fifty-pound fish are not unusual. The Fish Commission has for several years had a standing offer of a reward for a sixty-pound fish from the Potomac, but none has been forthcoming as yet. The largest Striped bass on record was one weighing one hundred and twelve pounds, taken at Orleans, Massachusetts, in the town cove. Such a fish would be at least six feet in length. A fairly proportioned bass thirty-six inches long would weigh at least eighteen pounds.

Uses.—The Striped bass is one of the most valuable of our food fishes, its flesh being firm, finely flavored, and hard enough to bear exposure to the air for some time without injury. It is also the most popular game fish, next to the salmon. Those in the markets are chiefly obtained in seines and traps, set at various points along the coast from the south side of Cape Cod to New Jersey. Great quantities are also taken in the shad seines in the spring. They may be readily taken, also, by heaving and hauling in the surf with menhaden bait, the fish being tolled by the use of great quantities of menhaden ground into small bits, and in fresh or brackish water by the use of the artificial fly. At various points on the coast of southern New England are club-houses, supported by wealthy amateurs for the purpose of carrying on these sports.

It has already been stated that the Striped bass are believed to be less abundant in the Gulf of St. Lawrence than in former years. Similar complaints are heard from the Bay of Fundy, and from Cape Cod, where the period of diminution is believed to date from the last advent of the Bluefish: about 1850. The bass fishery, in Cape Cod Bay, was formerly of great importance, but the capture of this fish is now of rare occurrence. The early settlers of New England seem to have been more impressed by the abundance of bass than by any other circumstances connected with the fisheries, and the early chronicles are full of allusions to their exceeding plenty and excellence.

Captain John Smith saw so many in one river, that he declared that he thought he might have walked across on their backs dryshod. While there can be no doubt that north of Cape Cod their numbers have decreased, there is no reason to believe that elsewhere on our coast the fisheries have had any especial effect upon them. A Hessian officer, writing in 1777, declared that enormous numbers were, at that time, brought to New York; and the same might be said at the present day. Three fishing gangs at Bridgehampton, New York, took over eight thousand in less than a week, in December, 1874. Captain Charles Ludlow secured at one set of his seine one thousand six hundred and seventy-two bass, or about three and a half tons. Shortly afterwards a

New London fisherman brought in four hundred and nineteen bass, one hundred and eighty-five of which had been caught with a hook in three hours, near Norfolk, Virginia. One thousand five hundred have been taken with a single set of the seine. A few years ago, it is said on credible authority that six hundred were once taken, the average weight of each being eighty pounds.

DISTRIBUTION OF FISH BY THE CALIFORNIA STATE FISH COMMISSION.

DISTRIBUTION OF TAHOE TROUT.

Distributed in September and October, 1888.

Localities and Remarks.	Number of Fish.
Squaw Creek	20,000
Lake Tahoe, at various points	245,000
Donner Lake	100,000
Dinkley and Buena Vista Creeks, Fresno County	30,000
South Fork of American River	20,000
Taylor Creek	25,000
Truckee River	105,000
South Yuba River	35,000
Shafer's Creek	7,000
Richardson's Creek	7,000
Barker's Creek and Lake	5,000
Gilmore's Lake	1,500
Watson's Lake	500
Total Tahoe trout (as reported by Mr. J. C. Frazier, October 27, 1888)	601,000

DISTRIBUTION OF SALMON.

Date.	Where Distributed and Remarks.	Number of Fish.
1888.		
Dec. —	McCloud River, from the United States Hatchery, by contract with Mr. Livingston Stone, at 75 cents per thousand	500,000

From Sisson Hatchery, for the Season of 1888-89.

Early Fall Run.

Date.	Where Distributed and Remarks.	Number of Fish.
1888.		
Dec. 23	Below Eighteenth Crossing, main Sacramento River	50,000
Dec. 24	Above Eighteenth Crossing, main Sacramento River	100,000
Dec. 25	Above Sullivan's, West Fork Sacramento River	100,000
Dec. 26	Near Stevens', West Fork Sacramento River	100,000
Dec. 27	West Fork Sacramento River	100,000
Dec. 28	Big Springs Creek, tributary Sacramento River	80,000
Dec. 29	Sulloway Creek, tributary Sacramento River	150,000
Dec. 30	Cold Creek, tributary Sacramento River	60,000
Dec. 31	Near Big Castle Creek, main Sacramento River	50,000
	Total	790,000

Late Fall Run.

Date.	Where Distributed and Remarks.	Number of Fish.
1889.		
Mar. 25	West Fork Sacramento River	156,000
Mar. 26	West Fork Sacramento River	144,000
Mar. 27	West Fork Sacramento River	72,000
Mar. 27	School House Spring Creek, tributary Sacramento River	144,000
Mar. 28	Big Spring and Sullivan Creeks, tributary Sacramento River	144,000
Mar. 28	Sulloway and Cold Creeks, tributary Sacramento River	104,000
Mar. 29	West Fork Sacramento River	144,000
Mar. 30	West Fork Sacramento River	144,000
April 3	Near Upper Soda Springs, main Sacramento River	84,000
April 4	Near Eighteenth Crossing, main Sacramento River	90,000
April 5	Near Mossbrae Falls, main Sacramento River	90,000
April 6	Near Mossbrae Falls, main Sacramento River	90,000
April 7	Near Dunsmuir, main Sacramento River	90,000
April 9	Near Lower Soda Springs, main Sacramento River	90,000
April 10	Near Little Castle Creek, main Sacramento River	90,000
April 11	Near Anderson's Mill, main Sacramento River	90,000
April 12	Three miles below Anderson's Mill, main Sacramento River	90,000
April 15	Near Big Castle Creek, main Sacramento River	90,000
April 16	Two miles below Big Castle Creek, main Sacramento River	90,000
April 17	Below Welsh's Mill, main Sacramento River	72,000
April 18	Below Eighteenth Crossing, main Sacramento River	60,000
	Total	2,168,000

DISTRIBUTION OF TAHOE TROUT.

From Tahoe Hatchery, 1889.

Date.	Applicant.	Where Distributed.	Number of Fish.
1889.			
Aug. 18		Blackwook Creek, tributary of Lake Tahoe	60,000
Aug. 24		Sea Gull Point, Lake Tahoe	35,000
Aug. 26		Near Saxon's Old Mill, Lake Tahoe	35,000
Aug. 27		At wharf, Tahoe City	20,000
Aug. 28		Off Island Ranch, Lake Tahoe	30,000
Aug. 29		Off Island Ranch, Lake Tahoe	40,000
Sept. 3		Meeks' Bay and Creek, Lake Tahoe	60,000
Sept. 3	Murphy Bros.	Small lake at the head of Meeks' Creek	8,000
Sept. 4	O. Roberts	Meeks' Bay, Lake Tahoe	60,000
Sept. 5	O. Roberts	Phipp's Creek, tributary of Lake Tahoe	60,000
Sept. 6	McKinney	Lake Tahoe, near Sugar Pine Point	60,000
Sept. 7	McKinney	Quail Creek, tributary of Lake Tahoe	60,000
Sept. 8	McKinney	In Lake Tahoe, near the snag	60,000
Sept. 10	M. Lawrence	Taylor Creek, tributary of Lake Tahoe	60,000
Sept. 13	M. Lawrence	Fallen Leaf Lake, tributary of Lake Tahoe	60,000
Sept. 14	Mrs. Vade Clark	Rubicon River, branch of Middle Fork of the American River	50,000
Sept. 17 and 18	Mrs. Kirby	Emerald Bay, Lake Tahoe	100,000
Sept. 18	M. Lawrence	Taylor Creek and Floating Island Lake	30,000
Sept. 20	A. J. Bayley	Burton Creek, tributary of Lake Tahoe	25,000
Sept. 23	A. J. Bayley	Truckee River, above Wardrusk Dam	60,000
Sept. 24		Blackwood Creek, tributary of Lake Tahoe	65,000
Sept. 27	Mr. Gilmore	Gilmore Springs, seven miles from Yank's	8,000
Sept. 29	Mr. Wentworth	Loon Lake and Buck Island Lake, headwaters Middle Fork American River	25,000
Oct. 2	A. L. Frost	Near Rubicon Point, Lake Tahoe	25,000
Oct. 5		Ward Creek, tributary of Lake Tahoe	20,000
Oct. 5	A. J. Bayley	Truckee River, below outlet of Lake Tahoe	6,000
Oct. 5	Com. Todman	Lake Tahoe, near Tahoe City	5,000
		Total	1,027,000

DISTRIBUTION OF SALMON.

FROM SISSON HATCHERY FOR THE SEASON OF 1889 AND 1890.

Early Fall Run.

DATE.	Where Distributed and Remarks.	Number of Fish.
1890.		
Feb. 3	Cold Creek, tributary of Sacramento River	100,000
Feb. 4	Sulloway Creek, tributary of Sacramento River	100,000
Feb. 5	Cold Creek, tributary of Sacramento River	100,000
Feb. 6	Sulloway Creek, tributary of Sacramento River	100,000
Feb. 7	Big Spring Creek, tributary of Sacramento River	140,000
Feb. 8	School House Spring Creek, tributary of Sacramento River	180,000
Feb. 10	Sulloway Creek, tributary of Sacramento River	150,000
Feb. 12	Big Spring Creek, tributary of Sacramento River	100,000
	Total	970,000

Late Fall Run.

DATE.	Where Distributed and Remarks.	Number of Fish.
1890.		
April 23	West Fork Sacramento River	80,000
April 25	West Fork Sacramento River	75,000
April 26	Upper Soda Springs, main Sacramento River	75,000
April 28	Near Dunsmuir, main Sacramento River	75,000
April 30	Near Eighteenth Crossing, main Sacramento River	45,000
	Total	350,000

DISTRIBUTION OF EASTERN BROOK TROUT.

DATE.	Localities and Remarks.	Number of Fish.
1890.		
June 7	Deer Creek, east of Vina, Tehama County, California, for Senator Stanford	12,000
June 6	Headwaters McCloud River, Siskiyou County	24,000
June 8	Shovel Creek, branch of Klamath River, for A. C. Tubbs, Siskiyou County	4,000
June 9	Big Springs, branch of Shasta River, Siskiyou County	8,000
June 9	Griffen's Springs, branch of Shasta River, Siskiyou County	2,000
June 8	Wadsworth Springs, branch of Shasta River, Siskiyou County	1,000
June 8	School House Springs, branch of Sacramento River, Siskiyou County	2,000
June 19	Headwaters of Shasta River, branch of Klamath River, Siskiyou County	8,000
June 19	Kaiser's Springs, headwaters of Sacramento River, Siskiyou County	6,000
June 25	West Fork of Sacramento River, Siskiyou County	16,000
	Total Eastern Brook trout	83,000

DISTRIBUTION OF TAHOE TROUT.

From Tahoe Hatchery.

Date.	Applicant.	Where Distributed.	Number of Fish.
1890.			
July 28	Com. Todman	Truckee River, above Ward Rush Dam (Rainbow trout)	8,000
July 29	M. Lawrence	Taylor Creek, tributary of Lake Tahoe	60,000
July 31	M. Lawrence	Fallen Leaf Lake	56,000
Aug. 2	M. Lawrence	Taylor Creek and Cascade Lake	60,000
Aug. 4	Mrs. Kirby	Emerald Bay, Lake Tahoe	60,000
Aug. 5	A. L. Frost	Near Rubicon Point, Lake Tahoe	56,000
Aug. 6	Mrs. Vade Clark	Rubicon River, branch of Middle Fork of American River	50,000
Aug. 8		Meeks' Creek, tributary of Lake Tahoe	52,000
Aug. 9	O. Roberts	Phipps' Creek, tributary of Lake Tahoe	56,000
Aug. 11	J. McKinney	Quail Creek, tributary of Lake Tahoe	56,000
Aug. 12	J. McKinney	McKinney's Creek, tributary of Lake Tahoe	50,000
Aug. 19	Mr. Gilmore	Gilmore Springs, seven miles from Yank's (several small lakes)	35,000
Aug. 21		Blackwood Creek, tributary of Lake Tahoe	60,000
Aug. 22	J. McKinney	Loon Lake (15,000), Summit Lake (5,000), Quail Lake (5,000)	25,000
Aug. 23	M. Lawrence	South Fork American River, fourteen miles from Tallac	35,000
Aug. 25	Com. Todman	Truckee River, above Ward Rush Dam (Rainbow trout)	38,000
Aug. 26	J. Moody	Donner Lake	50,000
Aug. 26	J. Moody	Headwaters Alder Creek, near Truckee	8,000
Aug. 27	Mr. Scott	Squaw Creek, tributary of Truckee River	8,000
Sept. 14	Mr. Scott	Squaw Creek, tributary of Truckee River	10,000
Sept. 17	H. D. Burton	Carnelian Bay, Lake Tahoe	20,000
Sept. 23	A. J. Bayley	Burton Creek, tributary of Lake Tahoe	20,000
		Total Tahoe trout	873,000

DISTRIBUTION OF BLACK BASS.

Date.	Applicant.	Locality and Remarks.	Number of Fish.
1889.			
Aug. 12	Senator Jones	Thermalito Reservoir, at Oroville, Butte County, Cal.	60
Aug. 17	J. D. Jordan	Clear Lake, Lake County, Cal.	160
Aug. 25	J. D. Jordan	Clear Lake, Lake County, Cal.	160
Aug. 31	W. G. Dickinson	Sweetwater Lake, National City, San Diego County, Cal. (40 per cent lost)	120
1890.			
Aug. 12	Pacific Imp't Co.	In lake at Del Monte, Monterey County, Cal.	40
Aug. 12	Pacific Imp't Co.	Reservoir in Pacific Grove, Monterey County, Cal.	60
Aug. 22	O. Weissman	Blue Lakes, Lake County, Cal.	69
Aug. 29	J. D. Jordan	Clear Lake, Lake County, Cal.	88
Sept. 4	A. C. Bassett	Sargent's Station, Pajaro River, Santa Clara County, Cal	40
Oct. 6	McD. R. Venable	City Reservoir, San Luis Obispo, San Luis Obispo County, Cal.	10
Oct. 6	McD. R. Venable	Laguna de San Luis, two miles west of San Luis Obispo City, San Luis Obispo County	50
		Total Black bass	857

DISTRIBUTION OF RAINBOW TROUT.

FROM SISSON HATCHERY.

DATE.	Name of Applicant.	Localities where Planted.	Number of Fish Shipped.
1890.			
July 15	Chas. Sonntag	Lagunitas Lake, Marin County	12,000
July 15		Lagunitas Creek, Marin Co., 5 miles below dam	8,000
July 20	S.V.W. Works Co.	San Mateo Ck., above reservoir, San Mateo Co.	40,000
July 23	J. B. Randol	Almanitos Creek, near New Almaden Mines, Santa Clara County	18,000
July 23	J. B. Randol	Guadalupe Creek, Santa Clara County	12,000
July 26	A. W. Ingalsbe	Smith's Creek, a branch of Calaveras Creek, Santa Clara County	12,000
July 26	A. W. Ingalsbe	Stevens' Creek, Santa Clara County	9,000
July 26	A. W. Ingalsbe	Saratoga Creek, Santa Clara County	9,000
July 30	Mr. Mendenhall	Arroyo Mocho Creek, Alameda County	18,000
July 30	Chas. Hadsell	Alameda and Calaveras Creeks, Alameda Co.	12,000
Aug. 3	J. R. Hebron	A branch of the Salinas River, Monterey Co.	12,000
Aug. 3	Chas. Romie	Arroyo Seco, branch of Salinas River, Monterey County	18,000
Aug. 11	John T. Doyle	Stevens' Creek, Santa Clara County	18,000
Aug. 11	John T. Doyle	Adobe Creek, Santa Clara County	12,000
Aug. 15	George Dennison	Boulder Creek, branch of San Lorenzo Creek, Santa Clara County	18,000
Aug. 15	George Dennison	Bear Creek, branch of San Lorenzo Creek, Santa Clara County	12,000
Aug. 19	F. Marriott	Los Gatos Creek, Santa Clara County	30,000
Aug. 23	J. G. Chesley	San Gregorio Creek, San Mateo Co. ($\frac{1}{3}$ lost)	30,000
Aug. 31	Dr. C. O. Dean	Paper Mill Creek, Marin County	30,000
Sept. 3	A. C. Bassett	In branches of Uvas Creek, Santa Clara Co.	30,000
Sept. 7	A. W. Stott	Sonoma Creek, Sonoma County	18,000
Sept. 7	T. Lake Harris	A branch of Russian River, near Santa Rosa, Sonoma County	12,000
Sept. 11	Dr. H. W. Smith	At Chili Bar, South Fork American River, El Dorado County	12,000
Sept. 11	Dr. H. W. Smith	At Moore's Bridge, South Fork American River, El Dorado County	3,000
Sept. 11	Dr. H. W. Smith	Near Dennis Johnson's, South Fork American River, El Dorado County	6,000
Sept. 11	Dr. H. W. Smith	Two Silver Creeks, branches of South Fork American River, El Dorado County	9,000
Sept. 18	C. F. Haswell	Cache Creek, near Ramsey, Yolo County	30,000
Sept. 23	F. L. Wooster	In branches of Napa Creek, near Napa, Napa Co.	30,000
July and Aug.	Edson Bros.	Shovel Creek, branch of Klamath River, Siskiyou County	130,000
Aug. 25		West Fork Sacramento River, Siskiyou Co.	25,000
Aug. 25		Sulloway Creek, branch of Sacramento River, Siskiyou County	25,000
Aug. 25		Cold Creek, branch of Sacramento River, Siskiyou County	15,000
Aug. 28		School House Creek, branch of Sacramento River, Siskiyou County	50,000
Aug. 28		In three creeks at Peter Klink's, branches of Sacramento River, Siskiyou County	50,000
Sept. 28		West Fork Sacramento River, Siskiyou Co.	50,000
Oct. 1		Near Dunsmuir, main Sacramento River	50,000
Oct. 2		Near Mossbra Falls, main Sacramento River, Siskiyou County	41,000
Oct. 3		Near Little Castle Creek, main Sacramento River, Siskiyou County	40,000
Oct. 6	McD. R. Venable	San Margarita Creek, branch of Salinas River, San Luis Obispo County	8,000
Oct. 6	McD. R. Venable	San Luis Creek, San Luis Obispo County	8,000
Oct. 6	McD. R. Venable	Chorro Creek, empties into Morro Bay, San Luis Obispo County	8,000
Oct. 6	McD. R. Venable	Laguna de San Luis, near San Luis Obispo City, San Luis Obispo County	10,000
Oct. 6	McD. R. Venable	Steiner and Venable Creeks, branches of San Luis Creek, San Luis Obispo County	3,000
Oct. 6	McD. R. Venable	Arroyo Grande, San Luis Obispo County	3,000
		Total Rainbow trout	996,000

DISTRIBUTION OF SALMON BY THE UNITED STATES FISH COMMISSION.

FROM McCLOUD RIVER HATCHERY.

DATE.	Localities.	Number of Fish.
1888.		
Nov., Dec.	McCloud River	1,000,000
1889.		
Nov., Dec.	McCloud River	84,000
	Total salmon	1,084,000

DISTRIBUTION OF TROUT BY PRIVATE HATCHERIES IN 1890.

KIND OF FISH.	Owner of Hatchery.	Place Planted.	Remarks.	Number of Fish.
Native trout	North Pac. Game and Fish Club	Sonoma Creek	From eggs taken from trout trapped in Sonoma Creek by permission of the California State Fish Commission	12,000
Rainbow trout	North Pac. Game and Fish Club	Sonoma Creek and Robinson Creek	From eggs shipped from the Shovel Creek Hatchery by the California State Fish Commission	90,000
Eastern Brook trout	North Pac. Game and Fish Club	Robinson Creek	(As reported by Mr. A. V. La Motte of the North Pacific Game and Fish Club)	25,000
Native trout	Alex. Badlam	Bear Creek	From trout trapped in Bear Creek, Napa County, by permission of the California State Fish Commission	15,000
Rainbow trout	Alex. Badlam	Sulphur Creek	From eggs shipped from the Shovel Creek Hatchery by the California State Fish Commission	20,000
Rainbow trout	Alex. Badlam	Lokonoma Creek	Near Middletown, Lake County, California	20,000
Rainbow trout	Alex. Badlam	Anderson Creek	Near Middletown, Lake County, California	20,000
Rainbow trout	Alex. Badlam	Grizzly Creek	Near Bradford's, Lake County, California	10,000
Rainbow trout	Alex. Badlam	Bradford Creek	Near Quicksilver Mine, Lake County, California	5,000
Rainbow trout	Alex. Badlam	Bear Creek	Near Arcadia, Napa County, California	15,000
Rainbow trout	Alex. Badlam	Troutdale Creek	Near Arcadia, Napa County, California (as reported by Mr. A. Badlam)	10,000
Rainbow trout	S. H. Knowles	Bear Creek, branch S. Lorenzo Creek	From eggs shipped from Shovel Creek Hatchery by California State Fish Commission	15,000
Rainbow trout	S. H. Knowles	In his private ponds	From eggs shipped from Shovel Creek Hatchery by California State Fish Commission	15,000
Rainbow trout	S. H. Knowles	Los Gatos Creek, Santa Clara Co.	From eggs shipped from Shovel Creek Hatchery by California State Fish Commission	10,000
Rainbow trout	Del Monte Hotel	Carmel River and reservoirs	From eggs shipped from Shovel Creek Hatchery by California State Fish Commission	40,000
			Total trout	322,000

RECAPITULATION.

Salmon distributed by California Fish Commissioners	4,478,000
Salmon distributed by United States Fish Commissioners	1,084,000
Eastern Brook trout distributed by California Fish Commissioners	83,000
Tahoe trout distributed by California Fish Commissioners	2,501,000
Rainbow trout distributed by California Fish Commissioners	996,000
Black bass distributed by California Fish Commissioners	857
Rainbow trout distributed by private hatcheries	322,000
Total	9,464,857
Salmon eggs in Sisson Hatchery October 15, 1890	3,000,000

THE FOOD FISHES OF THE CALIFORNIA FRESH WATERS.

By Dr. Carl H. Eigenmann.

The knowledge of the fresh-water fishes of California is at present more limited than that of any other State. It is, therefore, no easy task to present an account of the food fishes which shall at the same time be popular, or free from the technicalities of the ichthyologist, and scientifically exact. My personal observations have been confined to the southern and central counties of California, my explorations having been rather prematurely arrested. I hope, however, either this or the coming year to thoroughly explore every stream and lake in the State, and present you with a fuller report.

There is comparatively a very limited variety of fishes in California. A stream which, in the Mississippi Valley, would harbor seventy-five or a hundred different species of fish, would, in California, scarcely contain twenty. This is due to two causes.

CAUSES OF FISH SCARCITY.

I. Many of our streams become entirely dry during the summer, and no species that does not migrate to the sea or the lower or higher watercourses, can exist in them.

II. It is a law in the distribution of fresh-water fishes that the greater the water system the larger the number of species of fishes found in any of the tributaries. The tributaries of the Sacramento thus have much fewer species than the tributaries of the Mississippi, and the tributaries of the Mississippi much fewer than the tributaries of the Amazon. To be more precise, one naturalist has caught as many species of fishes in one of the tributaries of the Mississippi in a day as there are known from the entire region west of the Sierra Nevada.

NAMES OF FISHES.

I present a list of the fresh-water fishes now known from California, giving both the scientific and popular name:

Ammocœtes tridentatus Gairdner. Lamprey.
Ammocœtes cibarius Girard. Lead-colored Lamprey.
Acipenser transmontanus Richardson. White Sturgeon.
Acipenser medirostris Ayers. Green Sturgeon.
Catostomus aræopus Jordan. Kern River Sucker.
Catostomus rex R. Eigenmann. Klamath Sucker.
Catostomus occidentalis Ayers. Sacramento Sucker.
Catostomus tahoensis Gill and Jordan. Tahoe Sucker.
Chasmistes brevirostris Cope.
Chasmistes luxatus Cope.
Orthodon microlepidotus Ayers.
Lavinia exilicauda Baird and Girard.
Pogonichthys macrolepidotus Ayers.
Mylocheilus caurinus Richardson.
Mylopharodon conocephalus Baird and Girard.
Ptychocheilus oregonensis Richardson. Sacramento Pike.

Ptychocheilus rapax Girard.
Ptychocheilus harfordi Jordan and Gilbert. Sacramento Pike.
Phoxinus montanus Cope.
Phoxinus orcuttii E. and E.
Phoxinus conformis Girard.
Phoxinus bicolor Girard.
Phoxinus obesus Girard.
Phoxinus crassicauda Baird and Girard.
Phoxinus crassus Girard.
Phoxinus cœruleus Girard.
Algansea dimidiata Cope. Chub.
Algansea symmetrica Baird and Girard.
Algansea bicolor Girard.
Luxilinus occidentalis Baird and Girard.
Coregonus williamsoni Girard. Whitefish.
Oncorhynchus gorbuscha Walbaum. Humpback Salmon.
Oncorhynchus keta Walbaum. Dog Salmon.
Oncorhynchus tchawytcha Walbaum. Quinnat Salmon.
Oncorhynchus kisutch Walbaum. Silver Salmon.
Salmo gairdneri Richardson. Steel-head Salmon.
Salmo gairdneri irideus Ayers. Brook Trout.
Salmo purpuratus Pallas. Oregon Brook Trout.
Salmo purpuratus henshawi Gill and Jordan. Tahoe Trout.
Salvelinus malma Walbaum. Dolly Varden.
Gasterosteus williamsoni Girard. Stickleback.
Gasterosteus microcephalus Girard. Stickleback.
Archoplites interruptus Girard. Sacramento Perch.
Cottus asper Richardson.
Cottus semiscabrus centropleurus E. and E.
Cottus gulosus Girard.
Cottus minutus Pallas. "Catfish."

By saying that the number of species of fresh-water fishes is limited, I do not wish to imply that the food fishes are less in number or inferior in quality, but merely that we have less variety, a defect which can be remedied by introducing other species.

DESIRABLE SPECIES TO IMPORT.

The most prominent food fishes of the Mississippi Valley which are not indigenous to California, are the various catfishes, the buffalo, the pickerels, most of the sunfishes, especially the Black bass, the perches, and the bass. Several of these have already been introduced.

In the southern part of the State, where all but the mountain sources of the rivers dry up during the summer, we naturally have but few fresh-water fishes, and any attempts to stock these rivers are, of course, futile. There are but four different species of fishes in the fresh waters of San Diego County, exclusive of the Colorado River. One is a small killifish living in the hot springs of the Colorado Desert, another a small stickleback, a third a small minnow, while the only eatable fish is the *Salmo irideus*, which occurs, as far as known, only in Pala Creek. There is scarcely more variety till we reach the Tulare Basin. *Salmo irideus*, or the Brook trout, is the only food fish south of the Tulare Basin, and it never reaches a large size there. A few species of marine fishes run up the Southern California streams during spring. Chief of these is the mullet. When the dams of the Sweetwater reservoirs were opened, to clear part of the land of the water, large numbers of Sea bass ascended the stream thus formed. With these remarks Southern California may be dismissed.

The remainder of California may be divided into the Tulare, Sacramento, Klamath, and Tahoe regions, each of which has a different set of food fish. They are:

Tulare Region.	Sacramento Region.	Klamath Region.	Tahoe Region.
Kern River sucker.	White sturgeon. Green sturgeon. Sacramento sucker. Salmon. Brook trout. Salmon trout.	White sturgeon. Green sturgeon. Three species of suckers. Salmo purpuratus. Salmon trout. Dolly Varden.	Tahoe sucker. Tahoe trout. Whitefish. Chub.

There are besides these a number which are found in several of these systems. The trouts and suckers are, however, different for each system. Taking up the different species used for food separately:

ACIPENSERIDÆ, OR STURGEON.

The sturgeons are among the largest of the fresh-water fishes. Like the salmon they spend some of their time in the bays and ocean, and ascend the streams to spawn. There are two species found on the Pacific Slope, to which they are confined, those in the eastern rivers being quite distinct.

Acipenser transmontanus Richardson. White Sturgeon.

This sturgeon is said to reach a weight of six hundred pounds. It is almost daily brought into the San Francisco markets. Those offered for sale vary from two to seven feet in length. It is said to reach a length of twelve feet. It is sold in the restaurants as "tenderloin of sole." Large numbers enter all of the large streams from the Sacramento to the Frazier River.

Acipenser medirostris Ayres. Green Sturgeon.

This species is much rarer than the White sturgeon, but is not infrequently brought into the markets. It reaches as large a size as the preceding. The young of these two sturgeons differ greatly from the adult, and the young of the two species are not distinguished in the fish stalls. Dr. Jordan said ten years ago, that this sturgeon was reputed poisonous and not used for food. Although it is still looked upon with less favor than the White, or *the* sturgeon, it is no longer considered poisonous. This property is now ascribed to the young of this or of both species. The old can readily be distinguished from the White sturgeon by its rough skin and by the green band along the belly.

CATOSTOMIDÆ, OR SUCKERS.

The sucker is almost entirely a North American product; of the many species only two are found elsewhere. The suckers found in California are all species peculiar to the western slopes of America. The Buffalo fishes, which belong to this family, are not found on the Pacific Slope. All the species are more or less valuable as food. The California suckers all belong to the genera *Catastomus* and *Chasmistes*, and each river system has one or more which is peculiar to it. The majority ascend small streams in spring to spawn.

Catastomus aræopus Jordan. Kern River Sucker.

This is a small sucker, about thirteen inches long. Very little is known about it as yet.

Catostomus rex R. Eigenmann.

This sucker, reaching a length of three feet, is abundant in Tule Lake, and ascends the Lost River.

A specimen has lately been procured for the Academy of Sciences, through the kindness of Mr. Woodbury, of the Fish Commission.

Catostomus occidentalis Ayers.

This is the common Sacramento sucker, or "the sucker" of the San Francisco market. It is abundant in the whole Sacramento Valley, and descends some distance into tide water. I have taken it at Mare Island. It is not greatly esteemed as food.

Catostomus tahoensis Gill and Jordan. Tahoe Sucker; Red-sided Sucker; Black Sucker.

This sucker is found in the Truckee Basin. It ascends the rivers and rivulets tributary to Lakes Tahoe and Donner in June to deposit its spawn. The very young of this species are quite black; the half grown have a bright red stripe along the sides. In the early part of June these half grown ascend the small rivulets in such abundance that the Indians and others catch large quantities by placing a sack across one of the streams and then driving them down. The larger ones have the red lateral stripe less conspicuous than the half grown. They ascend the rivers at the time the young ones ascend the rivulets. In June none were seen in Lake Tahoe, and but few were being taken in Donner Lake. A few were taken in the Fish Commission's traps in June, and great quantities were seen in Donner Creek, especially in all deep holes.

Chasmistes brevirostris Cope.

This is a small sucker, reaching the length of sixteen inches. It is abundant in Klamath Lake, but does not ascend Williamson's River in spring.

Chasmistes luxatus Cope.

This sucker is also found in Klamath Lake, but reaches a much larger size, nearly three feet. "It ascends the streams in thousands in the spring, and is taken and dried in great numbers by the Klamath and Modoc Indians."

CYPRINIDÆ. The Carps or Minnows.

The American members of this family are mostly small, bony fishes, not fit for food. In the waters of the western slopes some of them attain a large size, however, the Sacramento pike reaching a length of five feet. They are usually very abundant where they are found at all, and form an important item of the food of larger fishes. The most important member of the family is the German carp, a native of Central

Asia, which has been copiously introduced into Europe and America. A large number of the species found in California are more or less valued as food, and are at times brought to the San Francisco markets.

Orthodon microlepidotus Ayres.

This is a small species, reaching a length of fourteen inches. It is abundant in the Sacramento, and is occasionally found in the San Francisco markets.

Lavinia exilicauda Baird and Girard.

This species resembles the preceding in size and distribution.

Pogonichthys macrolepidotus Ayres. Split-tail.

This is one of the commonest of the minnows. It is at once recognized by its widely forked tail.

Mylophardon conocephalus Baird and Girard.

This is one of the largest of the *Cyprinidæ*. It is said to reach a length of eighteen inches. It is rarely brought to the San Francisco market.

Ptychocheilus oregonensis Rich., and *harfordi* J. and G. Sacramento Pike; Whitefish.

There are two varieties of pike brought to the markets, but they are not distinguished by the fishermen. They are called pike from their resemblance to the true pike, from which they are, however, quite distinct, and to which they are not at all related. *P. oregonensis* is said to reach a length of five feet.

SALMONIDÆ. Salmons, Trouts, and Whitefish.

The *Salmonidæ* embrace the most important of our fish, both as regards food and sport. The genera which in California are of greatest value are *Coregonus*, *Oncorhynchus*, *Salmo*, and *Salvelinus*. They can readily be distinguished from our other fresh-water species by the adipose fin, and by the presence of scales. The genera found in California may be distinguished by the following characters:

a. Jaws toothless; scales rather large; habitually living in fresh water ---------- *Coregonus*, or Whitefish.
aa. Jaws with distinct teeth.
  b. Anal fin elongate; fourteen to seventeen rays, the tip of the highest ray rarely extending beyond the base of the last ---------- *Oncorhynchus*, or salmon.
  bb. Anal fin shorter; of nine to eleven developed rays.
    c. Vomer flat; its toothed surface plane; teeth on its shaft in pairs, or in a zigzag row; tip of the highest anal ray usually extending beyond the tip of the last ray ---------- *Salmo*, or trouts.
    cc. Vomer boat-shaped; its shaft strongly depressed; teeth on chevron only ---------- *Salvelinus*, or Charrs, or Brook trouts.

Unfortunately there is a confusion of names due to localities and variation in the species of this family which is frequently misleading. To this is to be added that very little is known as yet concerning the California trouts, so that many writers, basing their remarks on a few pickled specimens, have increased the confusion rather than helped us.

To this must also be added that the excellent figures accompanying many of the reports, and which pretend to give the differences, are based on specimens which differed widely in size, and are therefore misleading. This last fact has undoubtedly much to do with the confusion existing in regard to the Steel-head trout and Brook trout.

The discussions whether a given fish may be a trout or Salmon trout, while edifying to the man talking or writing, does not help us in the least to clear this matter.

In this connection it may be worth our while to examine the remarks of Dr. Günther on the variability of the species of the genus *Salmo*, remarks which Dr. Jordan had occasion to quote when studying these same fishes:

> There is no other group of fishes which offers so many difficulties to the ichthyologist, with regard to the distinction of species, as well as to certain points in their life history, as this genus.
>
> The almost infinite variations of these fishes are dependent on age, sex, and sexual development, food, and the properties of the water. * * * The *coloration* is, first of all, subject to variation, and consequently this character but rarely assists in distinguishing a species, there being not one which would show in all stages of development the same kind of coloration. The young of all the species of this genus are barred, and this is so constantly the case that it may be used as a generic, or even as a family character, not being peculiar to *Salmo* alone, but also to *Thymallus*, and probably to *Coregonus*. The number of bars is not quite constant, but the migratory trout have two (and even three) more than the river trout. When the salmons have passed the "parr" state, the coloration becomes much diversified. The males, especially during and immediately after the spawning time, are more intensely colored and variegated than the females, specimens which have not attained to maturity retaining a brighter silvery color, and being more similar to the female fish. Food appears to have less influence on the coloration of the outer parts than on that of the flesh; thus, the more variegated specimens are frequently out of condition, whilst well fed individuals, with pinkish flesh, are of a more uniform, though bright coloration. Chemistry has not supplied us yet with an analysis of the substance which gives the pink color to the flesh of many salmonoids; but there is little doubt that it is identical with, and produced by, the red pigments of many salt and fresh-water crustaceans which form a favorite food for these fishes. The water has a marked influence on the colors. Trout with intense ocellated spots are generally found in clear, rapid rivers, and in small, open, alpine pools; in the large lakes, with pebbly bottom, the fish are bright-silvery, and the ocellated spots are mixed with, or replaced by, X-shaped black spots; in pools or parts of lakes, with muddy or peaty bottom, the trout are of a darker color generally, and when inclosed in caves or holes they may assume an almost uniform blackish coloration. The brackish, or salt water, has the effect of giving them a bright-silvery coat, without or with comparatively few spots, none of which are ocellated. * * *
>
> With regard to *size* the various species do not present an equal amount of variation. Size appears to depend on the abundance of food, and the extent of water. Thus, the salmon and the different kinds of Great Lake trout do not appear to vary considerably in size, because they find the same conditions in all the localities inhabited by them.
>
> * * * * * * * * * * * * * * * * * *
>
> The *proportions of the various parts of the body to one another* vary exceedingly in one and the same species. * * * The *fins* vary to a certain degree. * * *
>
> Finally, to complete our enumeration of these variable characters, we must mention that in old males, during and after the spawning season, the *skin* on the back becomes thickened and spongy so that the scales are quite invisible, being imbedded in the skin.

Coregonus williamsoni Girard. Whitefish.

This fish is abundant in Lake Tahoe. It spawns in October and November in the tributaries of the lake. During the remainder of the season the adult is probably found in deep water. In June, schools of individuals, nine inches long, were seen on the eastern shores of the lake. In the evening when swarms of gnats were blown into the lake these Whitefish rose to them. A few were caught at the time with small hooks baited with fly. It reaches a length of nearly fifteen inches, and weighs about a pound. It ranks high as a food fish. Mr. Henshaw says of it:

> At Lake Tahoe it was found very abundant in October, being met with at that season in all the few streams that rise from the lake. * * * This month, and later, is

their spawning season, and as they pass up many are intercepted by the Indians, who find a market for considerable numbers in the settlements and logging camps about the lake. Having constructed a suitable net of mosquito netting, which is affixed to a long pole, the Indian, accompanied by one or two squaws, proceeds to the stream where it is sufficiently narrow for his purpose. Placing the net at the head of one of the deep sandy-bottomed pools which are found at every turn of the stream, he awaits quietly till all the fish near by have been frightened into it by the squaws, who advance from below, and beat the water with sticks. With a sudden scoop he usually empties the pool, taking perhaps from six to a dozen fish from each. All that we saw caught in this manner were quite small, averaging perhaps ten inches in length, but they attain a much larger size.

ONCORHYNCHUS. Pacific Salmon.

The members of the genus *Oncorhynchus* are confined to the North Pacific and the rivers flowing into it. They are generally termed salmon without distinguishing them from one another, or from the salmon of New England and Europe. They are by far the most important food fishes, and the Quinnat salmon probably surpasses in value all of our other fresh-water fishes combined.

Four of the five species known are found in the Sacramento; one of these is, however, only occasionally taken.

All of these species live in the sea, and ascend the rivers only at the spawning season. The Quinnat salmon enter the Sacramento in the spring and summer, and the run ceases, according to Jordan, in October. The larger individuals enter the river first, and the smaller ones, two feet long, do not run till July and August. Jordan says:

> The spring salmon ascend only those rivers which are fed by the melting snows from the mountains, and which have sufficient volume to send their waters well out to sea. Such rivers are the Sacramento, Klamath, * * * etc.
>
> Those salmon which run in the spring are chiefly *adults* (supposed to be at least three years old). Their milt and spawn are no more developed than at the same time in others of the same species which will not enter the rivers until fall. It would appear that the contact with cold fresh water when in the ocean, in some way caused them to turn toward it and to "run" before there is any special influence to that end exerted by the development of the organs of generation.
>
> High water on any of these rivers in the spring is always followed by an increased run of salmon. * * * The average weight of the Quinnat in the Sacramento in the spring is sixteen pounds.
>
> Those fish which enter the rivers in the spring continue the ascent until death or the spawning season overtakes them. Probably none of them ever return to the ocean, and a large proportion fail to spawn. They are known to ascend the Sacramento as far as the base of Mount Shasta, or to its extreme headwaters—about four hundred miles.
>
> At these great distances, when the fish have reached the spawning grounds, besides the usual changes of the breeding season, their bodies are covered with bruises, on which patches of white fungus develop. The fins become mutilated, their eyes are often injured or destroyed, parasitic worms gather in the gills, they become extremely emaciated, their flesh becomes white from the loss of oil, and as soon as the spawning act is accomplished, and sometimes before, all of them die.

Dr. G. Brown Goode says of this fish:

> Fifty years ago it was hardly known, except to students of natural history. Now it is known and eaten almost all over the world, for there is hardly a port in the world where ships have not carried the canned salmon of the Columbia, which is the same fish under a different name; and not only has this fish, in the form of food, traveled nearly all over the world, but the living embryos of the California salmon have been transported to England, France, Germany, Belgium, Denmark, Russia, Australia, and New Zealand, so that there is probably no one fish inhabiting a limited locality which is known over the world in so many different places as the California salmon.

The four species of *Oncorhynchus* found in the Sacramento are distinguished by the following characters:

a. Scales small, lateral line more than 200 .... *Gorbuscha.*
aa. Scales large, lateral line 125–155.
  b. Pyloric cœca 50–80; lateral line 125–135 .... *Kisutch.*

bb. Pyloric cœca 140 or more.
  c. Anal rays 13–14; branchiostegals 13–14 .... *Keta.*
  cc. Anal rays 16; branchiostegals 15–19 .... *Tchawytcha.*

Oncorhynchus gorbuscha Walbaum.

This, the Humpback salmon, is only occasionally taken in the Sacramento and Columbia. It runs every other year in Puget Sound. It reaches a weight of three to seven pounds.

Oncorhynchus kisutch Walbaum. Silver Salmon.

This salmon runs in the Sacramento in summer and fall; it does not exceed eight pounds in weight. and many are doubtless confounded with the young of the Quinnat. From this they are, however, readily distinguished by the number of cœcal appendages about the stomach, which scarcely exceeds seventy-five in this species, while there are more than one hundred and twenty-five in the Quinnat. Mr. Chas. Ohm took the young of this species, five and seven eighths inches long, in Paper Mill Creek, on March 24, 1890.

Oncorhynchus keta Walbaum. Dog Salmon.

I have not yet seen any fresh examples of this species. It is said to be abundant in the fall from the Sacramento northward, when it ascends all the streams for a short distance. It does not begin to "run" until its sexual organs are well advanced in development and its flesh proportionately deteriorated. For this reason it is of no great economic value.

Oncorhynchus tchawytcha Walbaum. Quinnat Salmon.

This is the salmon par excellence, and, like *Salmo salar*, "stands preeminent, like a Highland Chieftain, needing no name save that of his clan." It is still "The Salmon," "Quinnat Salmon;" and "King Salmon" when ready to be eaten, "Columbia Salmon "or "Alaska Salmon."

What I have said under the head of the genus *Oncorhynchus* in general applies to this species especially. I have caught the very young of this species (about two inches long) at Mare Island, on April 17, 1890.

SALMO.

The species of this genus are variously named by the fishermen. The young taken in the mountain streams are all Brook trouts, or Rainbow trouts; the old ones are Trout, Steel-head, Salmon trout, and even Salmon, and a special series of names has been invented in Lake Tahoe.

It is concerning the members of this genus that there was such discussion in the papers during last spring. For practical purposes, all the species of this genus may be classed as one, and covered by a general law protecting trout. All the rules of the angler will not suffice in distinguishing the species, and such practical experiments as scraping the scales with the thumb nail to distinguish Brook trout from Salmon trout, are perfectly useless. Every angler knows how variable the trouts are in the different streams and ponds, and Dr. Günther's words, quoted above, are but the expression of the experience of every naturalist, as well as of every angler. Through the courtesy of Mr. Charles Ohm, I have been able to examine about seventy-five Brook trouts from different streams, and others have come into my hands from Mr. Belding. Although the alcohol has obliterated most of the color markings, it can still be seen that no two streams have trout with exactly the same characters. To add to the confusion, the young of the salmon greatly resemble the trouts, and the old trouts greatly resemble the salmon. Young salmon have been brought to me as Brook trouts; and I bought a splendid Brook trout, nineteen inches long, which the fish dealer declared was a salmon, and willing to prove it by as large a bet as I would name.

I do not know where trouts have been planted, and where those so planted were procured, but the native species are distributed as follows:

1. The Brook trout, or Rainbow trout (*Salmo gairdneri irideus* Gibbons), in all mountain streams west of the Sierra Nevada from Mount Shasta to Lower California.
2. The Steel-head (*Salmo gairdneri* Richardson), from the Sacramento northward.
3. The Northern trout (*Salmo purpuratus* Pallas), from Mount Shasta northward.
4. The Tahoe trout (*Salmo purpuratus henshawi* Gill and Jordan), in the Truckee Basin, including Lakes Tahoe, Donner, Pyramid, and possibly Eagle.

It is thus seen that three of the trouts inhabit contiguous territory, while the other, the Steel-head, overlaps the territory of two of the species. There are, however, so many forms which are intermediate between the Brook trout proper and the Steel-head that the former may be looked upon as simply a southern form of the latter, or, conversely, the latter a northern form of the former.

These species and varieties are extremely hard to distinguish unless specimens of the same size are at hand. They may be determined by the following technical characters arranged by Dr. Bean:

a. No hyoid teeth.
  b. Anal rays, 12; depth of body equals length of head in young; tail of adult truncate .... *S. gairdneri;* Steel-head.
  bb. Anal rays, 10; depth of body much exceeds length of head in young; tail of adult forked .... *S. gairdneri irideus;* Brook, or Rainbow trout.
aa. Hyoid teeth.
  c. Head short; scales, not more than 170; gill rakers, 8–12; cœca, 20 .... *S. purpuratus;* Northern trout.
  cc. Head long, conical; scales, sometimes 184; gill rakers, 9–14; cœca, 50–60 .... *S. purpuratus henshawi;* Tahoe trout.

Salmo gairdneri Richardson. Steel-head Salmon.

This trout is not infrequently brought into the San Francisco market during the close season. At other times it is not so abundant, and in summer and fall it is rarely seen. It reaches a weight of twenty pounds. The California Academy of Sciences possesses a large specimen, the gift of Mr. Charles Ohm. It measures two feet five inches in length, and is a spent male.

There are several others smaller than this in the Academy's collection, presented by the same gentleman. It is more slender than the Rainbow trout or the Quinnat salmon, and does not ascend streams to any great distance.

Very little or nothing is known of the habits and life history of this species, and any notes on its migration, etc., ought always to be kept.

The young have very rarely been found, a fact which has led many to believe that the Brook trout are only the young of this species, especially as the latter are always, or usually, found in abundance in the same streams.

Salmo gairdneri irideus Gibbons.

This is the Rainbow or Brook trout proper. It is also known by various other names. There is no difficulty in distinguishing the adult of this species from the adult of the Steel-head, but the half grown are remarkably alike, and intergradations of all sorts are abundant. It does not attain nearly the size of the Steel-head, the largest recorded weighing but six pounds. These large examples are very rare. I have seen only one in the markets of San Francisco, and, as I have stated above, this was represented to be a young salmon.

The young are caught in large numbers in all the trout streams in Central and Southern California. It probably does not enter salt water as readily as the Steel-head, but it probably runs into the sea from short rivers which are dry in summer, and from others having a continuous stream of clear water.

It is a most excellent table fish, but not caught in quantity for the market. Its chief value seems to be to offer sport to anglers, and this is said to be of a very tame kind. It has been extensively introduced and seems to flourish in many eastern streams. Specimens have been taken in salt water near Oakdale, Long Island.

It varies more in size, color, etc., with the stream it inhabits than any other fresh-water fish.

Mr. Henshaw says of this species:

> This is the common Brook trout of the small mountain streams of the Pacific Slope, and up to an altitude of nine thousand feet it is the rare exception to find a suitable stream that is not well stocked with it. Upon many of them, as the tributaries of the South Fork of the Kern River, these trout are found in very great abundance, each pool and rapid numbering its finny denizens by the score. They may be taken in any sort of weather, at any hour of the day, by almost any kind of bait. During the heat of the day they frequent almost entirely the deeper pools, lying under overshadowing rocks or in the shade of some convenient log. In early morning or late afternoon they come out and run more into the shallows and rapids, under which circumstances they bite best and afford the finest sport. Like the average Brook trout the species rarely attains any considerable size, ranging from four to eight or more inches in length. Their colors are usually very bright, and for beauty this species takes rank among the foremost of its kind, and has well been called the Golden trout. In this respect, however, it is subject to the usual variation obtaining in the family, the change of color not only accompanying a difference in locality, but being plainly discernible in individuals taken in different parts of the same stream not far distant. In fact, as a specific character, color in this family seems to be at its lowest value. The character of the bottom and water itself has much to do with this, and I remember to have fished in a small rivulet on one of the subalpine meadows not far from Mount Whitney, whose sluggish waters flowed over a bottom of dark mud, in which the color of the trout simulated very closely its hue; they had lost nearly all the flashing iridescent tints characterizing the same species caught but a few hours before in another stream, and had become dull and somber-hued. Accompanying this change of color was a correspondingly noticeable difference in the habits and motions, and the several dozen trout caught that evening for supper were taken out by the hook with the display of very little more gaminess than would be noticed in so many Horned pout. On the contrary, in the clear rapid current of the mountain stream, a flash of sunlight is scarcely quicker than the gleam of gold and silver, seen for a single instant, as the whirling waters are cut by one of the trout as he makes a rush from his lurking place for some chance morsel which is being borne past him. The western trout are rarely as shy as their relatives of eastern waters, and because of their numbers and consequent scarcity of food are apt to be less fastidious; yet even when most abundant due caution must be used if one would be successful, and not every one can catch trout even in the West. With the proper care in concealing one's self a pool may be almost decimated ere the alarm will be taken, and I have seen fifteen fair sized trout taken from a single small pool in quick succession.

Salmo purpuratus Pallas. Oregon Brook Trout; Salmon Trout; Lake Trout.

I know nothing personally of this fish. It "is very abundant in all the waters north of Mount Shasta, and through the Great Basin and Rocky Mountain region; occasionally southward to Santa Cruz." It seems to have skipped California, except some parts of it; is found in abundance to the north of us, and extends farther south than any other salmon, having been "obtained by Professor Lufton from streams of the Sierra Madre, Mexico, at an elevation between eight and nine thousand feet in the southern part of Chihuahua, near the boundaries of Durango and Sinaloa." It occasionally reaches a weight of twenty-five pounds in the Columbia. These large ones are known as Steel-head, the young as Brook trout, and the partly grown as Salmon trout. It is of considerable importance economically, and its introduction into all streams suitable to it is to be recommended.

Salmo purpuratus henshawi Gill and Jordan.

This, the Lake Tahoe trout, is of greater economic importance than the others. It is abundant in the San Francisco markets all through spring. The fishermen of Lake Tahoe keep their catch alive till they have a sufficient number to warrant a shipment, when they are killed, boxed, and shipped to San Francisco. The past year one company had the entire control of the Tahoe catch.

This fish is known under various names to the fishermen and anglers of Lake Tahoe, who consider the variations, due to age, sex, depth of water, and character of bottom, all of specific value. If we keep in mind, however, the statements made by Dr. Günther, all the variations can easily be explained. The trout reported to me while at Lake Tahoe last June were: First, the Big Black trout, reaching a weight of twenty-nine pounds, and spawning in the rivers in April and May. Second, the Red trout, probably not exceeding a weight of seven pounds, which spawns in the streams from May to the first of August. Third, the Pogy or Porgy, weighing one and a half to two pounds, and spawning the latter part of August and during September. Fourth, the Silver trout, reaching nearly seventeen pounds in weight, and spawning in the lake in October and November. Fifth, the Yellow Belly or Sulphur Belly, the time and place of spawning not determined. Sixth, the Brook trout, found in the streams about Lake Tahoe.

In this connection I can but quote, with slight modification, what we have said elsewhere—"San Francisco Chronicle," August 31, 1890:

> The so called Big Black trout we did not see. The eggs of this large trout are larger than those of the Red trout, and grayish in color; the young are also gray. The eggs and young of the Red trout are almost cherry red, and the pigment of the young, reared in the hatchery, is much more developed than in those of the big trout. The facts brought to our notice would seem to indicate that the big trout is a species distinct from the Red trout. It would not, however, be surprising if this should prove to be only the adult form of the Red trout. The difference in the size of the egg, and in the time of spawning, is not without its parallel in sea fishes, and the difference in color is, as we have seen, easily accounted for.
>
> The Red trout has meat of a light pink color. The branchiostegal membrane is bright red. The females which have deposited their ova are quite silvery, while the males which have spawned are of a dark cherry color on the sides, darker above and lighter below. All the numerous individuals seen were pretty uniformly spotted.
>
> The Porgy is unquestionably the young Red trout during its first spawning season. "It is so fat that it may be fried in its own grease." The later time of spawning is readily accounted for by the youth of the Porgy, while its place of spawning (in the lake) is made

a necessity by the fact that, in all but unusually late seasons, like the present, the streams emptying into the lake become dry by the time this fish is ready to spawn. In color the Porgy is intermediate between the male and female trout, but the spots are much less regular.

The Silver trout may readily be distinguished at a glance in life, but the Porgy is readily taken for a Silver trout when life is extinct. Two Porgies purchased at the wharf of Tahoe City appeared to be Silver trout when they reached our hotel. The meat is of a salmon color. Many of the Silver trout are, without any doubt, the Red trout at a stage younger than the Porgy. If the assertion be true, that the Silver trout attains a weight of seventeen or eighteen pounds, the lack of color is doubtless due to the surroundings.

The Yellow-belly is a Silver trout from a different bottom, which has changed the silvery to yellow.

The Brook trout of this region are merely the young of the Red trout. They are quite distinct from the true Brook trout (*Salmo irideus*).

It will thus be seen that the trout of Tahoe belong at most to only two species, and very possibly to a single one.

At the fish hatchery of the State Fish Commission, located at Tahoe City, thousands of trout are now being hatched. The troughs at the hatchery are filled with the trout in all stages of development, from the currant-like egg to the food-hunting fish an inch long, which has lost its yolk-sac, or source of nourishment.

Salvelinus malma Walbaum. Dolly Varden; Red-spotted Trout.

This is another species concerning which I have no personal knowledge. It is indigenous to the region west of the Cascade Range, from Northern California to Alaska. According to Goode it is the most important of our chars, next to the Eastern Brook trout. It descends to the sea, and reaches the weight of fourteen pounds, but in the mountain streams it spawns at a length of six or eight inches. They are reported to spawn late in the fall in the rivers.

CENTRARCHIDÆ. The Sunfishes.

Archoplites interruptus Girard. Sacramento Perch.

This is the only California representative of the numerous species of sunfishes inhabiting North America. It is found throughout the Sacramento and San Joaquin Valleys, and descends to tide water. It is not frequently brought into the market, and is of no great economic value.

HOLCONOTIDÆ. Viviparous Perches.

Hysterocarpus traski Gibbons. Viviparous Perch.

The economic value of this fish is entirely incommensurate with its scientific interest. It does not reach a large size. It is found throughout the Sacramento Valley. It is the only American fresh-water representative of the viviparous family *Holconotidæ*, of which there are so many species along the entire coast of California. While all our other fresh-water fishes deposit spawn, this species brings forth living young in an almost mature stage.

Its characters have been so changed, probably by its permanent stay in fresh water, that it now represents a sub-family quite distinct from its marine relatives.

COTTIDÆ. Sculpins.

The members of this family are mostly marine, and species of *Cottidæ* abound along the entire coast of California. Some of them reach a large size, and are brought into the markets; but most of them are small and of no importance.

Cottus. Bullheads; Miller's Thumbs.

The remaining species of fresh-water fishes are all small, and only indirectly of economic interest. Our account of the one found at Lakes Tahoe and Donner will serve for them all.

Large individuals (about seven inches is large for this fish) are especially abundant near the hatching house of the Fish Commission, where the dead trout eggs are thrown each day. A handful of trout eggs is certain to bring a bullhead from under every stone in the vicinity. This fish is related to the *Oligocottus analis*, a marine species of bullhead living in tide pools on the coast of California, which changes, according to food and surroundings, from a grass-green to gray of various patterns. The changes in color of *Cottus minutus* are no less striking. Over a muddy bottom this species is quite black, assuming a drab or "sand color" over sandy bottom; while over rocks and pebbles it is conspicuously banded with light and dark. The bullheads are very destructive to the trout. They lie in wait for them at the mouths of creeks for the descent of the young ones. The bullheads, in their turn, form the principal food of a species of *Eutenia*, abounding on the shores of the lake.

WHY SALMON ARE SCARCE.

LETTER FROM DR. H. W. HARKNESS, PRESIDENT OF THE CALIFORNIA ACADEMY OF SCIENCES.

Upon reëxamining the subject, with the view of determining the cause for the scarcity of salmon in our rivers, we find that the principal agent engaged in their destruction is man.

Man accomplishes this in various ways—by the fouling of the rivers by manufactories, by dams or other obstructions, and chiefly by seine fishing.

The modern appliances are so perfect, and the pursuit of fish so active and persistent, that we are convinced that should the fishermen comply with the law in every particular, even then the salmon would disappear altogether from our waters; but when we take into consideration the fact that all unfair means are resorted to for the purpose of increasing the catch, we are no longer at a loss to account for their scarcity.

If our fishermen would but pay a decent respect to the laws, and furthermore would capture only a sufficiency for the supply of the market with fresh salmon, our rivers, with assistance from the State in the way of restocking at intervals, might still continue to be productive for an indefinite period.

There is one source of waste, as we look upon it, however, which should be prevented by the authorities, viz.: the canning interest. From time to time the Government has expended large sums of money for the purpose of stocking our rivers with salmon. This is the act of a paternal government with the sole idea, as we view it, of furnishing to all of the inhabitants of the State, so far as it is possible to do so, an opportunity for supplying the table with a cheap, nutritive article of food.

The taxpayers at large are called upon to pay the cost, and all are alike to share in the benefit. Let us examine for a moment, to see if there is a fair distribution of the results of this outlay. If, as has been previously stated, after the stocking of the rivers, fishing was conducted in accordance with the laws (fishing being prohibited during certain days, in order that a percentage of the breeding fish might escape); also, that the close season should be strictly observed, and further, that the exportation of fish should cease under these conditions, we believe that our rivers would, for an indefinite period, continue to furnish salmon in quantity sufficient to meet the home demand.

No sooner, however, does the salmon appear in tolerable abundance than the canner begins his work. Either by hiring boats and fishermen himself, or by offering tempting rewards to the fisherman for his catch, he is enabled to cover the river with boats in such numbers as to capture a large proportion of the product of the stream before they can pass his establishment.

If the fish so captured from the Government preserves were distributed as canned provisions among our people, there would be some slight excuse; but when we come to learn that all, or nearly all, are shipped away to foreign countries, we begin to realize that the people are being defrauded of their just dues.

The canner may claim that he is realizing but a small percentage of profit, or he may affirm that he has met with material loss, yet this has nothing to do with the subject. He is responsible for the increase of the price of fresh fish, and he is to be blamed for the final exhaustion of the rivers. There is no river, however rich it may be in salmon, but must eventually become impoverished if the canner is to be allowed to pursue his vocation, even when under limited Government surveillance.

During one year, some time back, there were two thousand men and one thousand boats engaged in the salmon fisheries of the Sacramento River alone. How many of these were employed by the canners we are unable to determine. As his means of canning fish are practically unlimited, and he has the world for a market, the canner has but to increase his fishermen until the stream is so far exhausted as to be of no further value.

In our judgment, the business of the canner should cease, or else the Government should abandon the plan of stocking the rivers when the results are so unsatisfactory.

We feel that this is a question of the greatest importance, and that the attention of the authorities should be called to it, and that the facts should be set forth so clearly as to induce them to take steps to remedy the evil.

To illustrate the case still more fully, we will suppose that our rulers should, while acting in the capacity of a paternal government, determine to set aside a large tract of land for a deer park, where large bands of these animals might be cared for with the view ultimately that venison should be furnished cheaply at certain seasons to the people of the State. What would be said of the economy of such a proceeding if the Government, during the hunting season, should permit individuals to kill the deer without hinderance for the purpose of canning the flesh so secured and sending it away to a foreign market?

BIENNIAL REPORT

OF THE

STATE BOARD OF FISH COMMISSIONERS

OF THE

STATE OF CALIFORNIA,

FOR THE

YEARS 1891–1892.

COMMISSIONERS.

JOSEPH D. REDDING, President, San Francisco.
RAMON E. WILSON, Secretary, San Francisco.
JOSEPH MORIZIO, Treasurer, San Francisco.

SACRAMENTO:
STATE OFFICE, : : : : : A. J. JOHNSTON, SUPT. STATE PRINTING.
1892.

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REPORT.

To H. H. Markham, *Governor of the State of California:*

The State Board of Fish Commissioners herewith present, in compliance with the law, a report of their official operations, commencing with the 17th of March, 1891, and ending with the 1st of September, 1892, being the biennial report of the Board of Fish and Game Commissioners of the State of California.

The State Board of Fish Commissioners, as at present organized, was appointed by your Excellency on the 28th of June, 1891.

The first formal meeting of the Board was held on the 13th of April, 1891. At this meeting a permanent organization was effected, and Mr. Joseph D. Redding was elected President of the Board, Mr. Ramon E. Wilson, Secretary, and Mr. Joseph Morizio, Treasurer.

Since the first meeting as above stated, the present Fish Commission has held twenty-one meetings at the office of the Commission, and upon the following dates:

1891—March 17, formal meeting.
April 13, called meeting.
April 17, called meeting.
April 28, called meeting.
May 11, called meeting.
June 4, called meeting.
June 18, called meeting.
August 8, called meeting.
August 28, called meeting.
September 11, called meeting.
1891—October 8, called meeting.
November 6, called meeting.
1892—January 15, called meeting.
February 15, called meeting.
March 1, called meeting.
April 2, called meeting.
April 27, called meeting.
May 3, called meeting.
May 10, called meeting.
August 2, called meeting.

At each of the above meetings a majority of the Fish Commissioners were present, and a complete minute-book has been kept of all proceedings had, which minute-book is now in the office of the Commission, and open to inspection.

Immediately upon the organization of the Board, they proceeded to appoint assistants. Thomas Tunstead was selected as Chief of Patrol, and John P. Babcock and F. M. Bacigalupi as his deputies. George H. Koppitz was appointed License Collector, and Samuel C. Mills assistant to the Secretary.

The office of the Commission was established at Room No. 27, 419 California Street, San Francisco, where it has since remained.

Having thus organized, the first discovery made by the Board was that all of the funds available to the Commission for the balance of the forty-second fiscal year had been entirely exhausted; and more than that, that there was a large outstanding indebtedness, arising from unpaid bills of the old Board, the amount of which is fully set forth in a detailed statement hereto attached.

The business of the Commission has steadily augmented, and the importance of more stringent fish and game laws is fast becoming appreciated by the great majority of our citizens.

The territory of the State of California is so large in area, and the number and variety of its streams and waters, and diversity of game, so greatly in excess of those of any other State of the Union, and in fact of any number of States, that it is hard to appreciate the volume of work that the Commissioners and their deputies are called upon to perform.

The two chief divisions of our labors are, respectively, the Patrol and the Hatchery Departments. Under the former is included the maintenance of the fish and game laws. For this purpose, under the present law, there is an annual appropriation of $5,000. With this amount at hand we are supposed to engage competent deputies to patrol the various wharves and fish markets of San Francisco and the other large cities of the State; to watch all of the avenues of ingress, and prevent the importation of certain fish and game when out of season; to keep a vigilant eye on the 250 miles of the bay lines of San Francisco and confluent bays and rivers, and to make continuous trips from one end of the State to the other, and throughout the length and circumference of all of its streams and waters, for similar purposes.

THE PATROL DEPARTMENT.

It is impossible, with the small appropriation allowed us for this department, to properly carry out that portion of the law which makes it the duty of the Commission to protect and preserve the fish and game in this State. It is hardly necessary to give any reasons for this, for they must be apparent to every one who will give the matter one moment's thought. If we undertook to patrol the State in detail, the actual traveling expenses of the deputies alone would exhaust the fund. Appreciating this, the Commission has devoted almost its entire attention to what it conceived would produce the best results, namely:

First—The prevention from sale in the markets of San Francisco of fish and game at the time when it is unlawful to sell the same.

Second—The prevention of illegal fishing in the bay of San Francisco, especially in the catching of the young of fish.

Third—The prevention of illegal fishing in the Sacramento River.

Fourth—The prevention of dumping sawdust and other deleterious substances into the various rivers and streams of the State.

Fifth—The requiring of the construction and maintenance of fish ladders.

What we have been able to accomplish in this direction will be shown in detail by the reports of our deputies and excerpts therefrom, which are attached to and made a part of this biennial report.

It requires a particular fitness to be a competent deputy in this department. The patrolmen are called upon to undergo all kinds of hardships, to be exposed to wet weather at all times of the day and night, and to come in contact with some of the most brutal and irresponsible classes of men. The position demands shrewdness, bravery, and executive ability of high order, besides a thorough familiarity with the topography of our State. In order to properly fulfill the work of this department and to employ a sufficient number of competent men, there should be an annual appropriation of at least $20,000, to be used entirely in this division of the labors of the Commission. Besides the patrol work and arrest of violators of the fish and game laws, there follows an immense amount of labor in the trial and conviction of the offenders. The deputies making the arrest have to be present at the trial. This, coupled with the customary delays of legal procedure, demands a great deal of time, and often prevents our employés from doing important service in other directions. Only by a sufficient appropriation can the Commissioners hope to even partially fulfill the duties which are prescribed to them in this behalf under the law.

The exclusive attention of our deputies has been given to the Patrol Department ever since their appointment. We beg to express to you our satisfaction in what has been accomplished in this matter of the prevention of the sale of fish and game in the markets, and especially with the results which has been accomplished in the prevention of the dumping of sawdust into the Sacramento, Truckee, and other rivers and streams, and also in the establishment and maintenance of fish ladders in the Truckee River and other places. Our most difficult labor has been found in the neighborhood of the bay of San Francisco, and in the Sacramento River. We believe that we have accomplished all that our funds would permit us to do. Your attention is called to the fact that the shore line of the bay and the Sacramento River alone covers a distance of more than two hundred and fifty miles. The fishing business is carried on and conducted at all points on the Sacramento River, from the city of Sacramento to the mouth of the river, and all points on the bay. As above suggested, the sum of $5,000 is absolutely inadequate, if devoted exclusively to this department, to accomplish much active results. The sum of $20,000 would permit the Commission to not merely threaten the arrest of the violators of the fish laws by infrequent visits, but, on the contrary, to accomplish their arrest and conviction in every instance.

LICENSES.

The Commission early appreciated that the matter of the collection of licenses, owing to the small amount appropriated for the benefit of the Commission by the Legislature, was an important matter, and if properly and successfully conducted, would add materially to the funds of the Commission. Under the law requiring all persons engaged in the avocation of fishing, with boat and net, to pay a license, the Commission is authorized to pay to the collector of licenses a percentage upon the amount of his collections, namely, 15 per cent.

So far as the city of San Francisco is concerned, there is no doubt but what the compensation, so provided, is fair in proportion to the services performed; but when it is considered that all the expenses of collection have to be borne by the collector, such compensation, for collections outside of the City and County of San Francisco, is entirely inadequate. In other words, the percentage thus provided for would not pay expenses, particularly so on account of long distances.

In most of the bays, rivers, and harbors outside of the city of San Francisco, the number of men engaged in the avocation of fishing is comparatively small—as, for instance, in Humboldt Bay, Tomales Bay, Monterey Bay, and San Diego Bay. Appreciating this condition of affairs, the Board concluded to appoint a deputy with a fixed monthly salary, whose principal duty should be to collect licenses.

It was early learned that no provision had heretofore been made for ascertaining or locating the various individuals throughout the different portions of the State who were engaged in the occupation of fishing.

When the vast extent of territory included within this State is considered, it can be readily understood that the accomplishment of this object is a very difficult one, and yet without it the law would be inoperative and useless.

We beg to call your attention to the expense bills which are hereto attached, and particularly to those items thereof which were incurred in the early work of the Commission in the matter of the collection of licenses. When it is considered that that work was absolutely necessary for the purpose of establishing a correct foundation and system for the more perfect collection of licenses, and when the work accomplished at that time is compared with the results as shown by the reports of the License Collector for the year 1890, there can be but one conclusion, and that is that the money has been well expended. The Commission is prepared at the present time to turn over to its successors a fairly complete list of all individuals and sets of individuals who are engaged in the avocation of fishing with boat and net in the waters of this State, with the exception of the extreme southern portion of the State, which, from lack of means, we have not been able to canvass. As will be seen from the amount of moneys which have been collected from this source, the collection of licenses is a very important matter to the Commission. We feel confident in stating that we have inaugurated the proper system for the accomplishment of the end which was intended, and that if this system is followed out for some length of time, the objects of the law will have been fully accomplished, and the funds of the Commission very materially increased. In this connection it is proper for us to call your attention to the fact that the fishing industry in this State has materially decreased in certain localities within the past two years, and this is especially so in the Sacramento and San Joaquin Rivers, although, as hereinafter shown, the salmon-canning industry has revived, owing to the unusually large run of salmon this year.

The collection of licenses from fishermen is a very difficult undertaking, for the reason that almost the entire fish industry of this State is carried on and conducted by foreigners, principally by Italians, Greeks, Slavonians, and Chinese, half of whom neither understand nor speak the English language. With the system already established, and which we intend to more fully perfect, we feel confident in saying that our next report will show a very material increase in the funds of the Commission from this source.

THE SALMON RUN.

An extraordinary increase in the salmon run has been noticed in the Sacramento River this year, and to such an unusual extent that the several canning establishments along that river, which have remained closed for some time past, have reopened and are doing a thriving business. It is difficult to ascribe the proper cause for this unusual run. Whether it is the actual result of the several millions of young salmon deposited by the Commission in the headwaters of the Sacramento and the surrounding streams within the last six years or not, we cannot say. It is generally supposed that the salmon returns from the sea, as near as possible to the headwaters, and, in fact, to the exact locality where it was hatched. On the other hand, the run of the present season is out of all proportion to that of any other preceding year within the last decade, and does not appear to be the natural increase from the work of the Commission in hatching and depositing these fish in the streams enumerated.

The report of the Norwegian Fish Commissioners for the year 1889 makes note of this same anomaly, namely: the unusual and enormous run of salmon up their rivers during one year after several preceding years of very inferior runs. They seek to account for it on the theory that the salmon, after leaving the fresh waters of its birthplace and gaining the sea, has no fixed or regular period, so far as the years are concerned, for returning to the fresh waters, but is likely to do so at any time after migrating indiscriminately in the deep waters of the ocean.

Attached to this report and made a part hereof is the report of the Superintendent of the State Hatchery at Sisson, California, Mr. J. A. Richardson, setting forth in detail the number of salmon eggs received from the United States Government during the last two years, the number hatched and planted, and where planted and distributed during the same period.

SHAD.

The shad planted by the first State Commission, some fifteen years ago, have become one of the most plentiful of our fishes, is a staple article in our markets, and obtainable for less price than in any other portion of our country. Such practical results from the introduction of a fish hitherto unknown in our waters are very gratifying.

This fish in our waters is equal in every particular to the same fish found in its native haunts. In this connection, however, we would call attention to the necessity of shad being handled with great delicacy from the time it is caught until it is placed upon the table to eat. The fiber of the flesh is very tender, easily bruised, and at once softens and loses the quality of its taste by indiscriminate and improper handling. Mr. Blackford, the well-known Fish Commissioner of the State of New York, suggests in a recently published article, that the shad when caught should be packed belly upwards, and handled as carefully as ripe fruit should be for the purpose of transportation.

STRIPED BASS.

The transplanting of striped bass has been equally as successful as that of the shad, and this delicious fish is now found in our waters and has become a permanent source of food supply in our markets. There is an important matter in this connection we beg to call your attention to, and that is that a law should be framed for the protection and preservation of striped bass. This fish seeks the slack waters of the rivers and bay for spawning. The young fish remain for some time in the waters of their birthplace, and during the period of their growth are being caught in large quantities by the fishermen, instead of being protected.

There should be a law passed making it a misdemeanor to catch, take, or have in one's possession a striped bass under two pounds in weight.

BLACK BASS.

The Commission, through the courtesies of the Spring Valley Waterworks, have been enabled to obtain a few black bass, which we have distributed, and we are at this time engaged in the same work.

LOBSTERS.

In May, 1888, the United States Fish Commission at Washington sent a carload of Atlantic lobsters (*Homarus Americanus*) to this coast, consigned, for delivery at Monterey Bay, to two of the State Commissioners. The car was in charge of Mr. Frank Ellis, one of the deputies of the United States Commission, and most experienced in the transportation of fish. Over one hundred and sixty full-grown lobsters were placed in Monterey Bay, off the shore and near Point Pinos. These lobsters arrived in a healthy condition and full of vigor, and when placed in the waters swam away with great rapidity, seeking their natural haunt at the bottom, among the rocks. Over thirty thousand young lobsters also were deposited in and around the same locality.

Since this deposit was made no definite and reliable information has been received that the lobsters have thrived. Reports have come to us that one or two of the mature lobsters were washed up by the waves on the Monterey beach some two years after their transplanting, alive and in good condition. They were at once placed back into the sea, as the fishermen of Monterey Bay were duly informed of the effort made to transplant this most edible of fishes, and have apparently been only too willing to assist the Commission in its labors. None of the young lobsters have been heard from. There is a standing reward for the production of the first live lobster, which at the present time remains unclaimed. There would seem to be no reason why the lobster should not thrive on our coast. The temperature of the waters of the bay is exactly identical with that of Woods Holl, where the lobsters were taken, on the Atlantic Coast. The saline quality is likewise the same. It may be that the lobster fails to find similar food to that to which it is accustomed in the Atlantic, or that there is some unknown enemy which has devastated them. Four years are ample time to mature the young lobster, and if the experiment has been a success we should certainly have definite results at the latest within another year.

FRESH-WATER CRAY-FISH, OR ECREVISSE.

These fish, which are indigenous to our State, and at one time most plentiful in the fresh-water streams around our bay, have become almost exterminated through the unlimited taking of the same for food purposes. We suggest that a law should be passed making it a misdemeanor for the period of the next three years to take, catch, or have in one's possession any of these fish.

STEAM LAUNCHES AND BOATS.

We are compelled to hire during almost every month of the year a steam launch, row boats, and yawls. This we are expected to pay for out of the sum of money appropriated for the Patrol Department, and as above indicated, the same is entirely insufficient. We were particularly fortunate at the outset of our work in having donated to us the steam launch of Commissioner Joseph Morizio, who gave the Commission the use of it without charge for several weeks, thus reducing our expenses considerably.

HATCHING DEPARTMNET.

At the outset of the present Commission's work, there being no funds of any kind available, we were obliged, for the time being, to abandon all attempts to operate the Hatchery Department. The result of this was that the spring run of trout was entirely lost, and no ova were obtained from the trout in this State during the whole of the year 1891, with the exception of 88,000 taken by the Commission under a contract with Messrs. Stevens & McKenney, at Independence Lake, a report of which is hereto attached.

When this Commission took office there were two hatcheries belonging to the State, one located at the town of Sisson, in Siskiyou County, and the other at Tahoe City, Lake Tahoe.

The hatchery at Lake Tahoe is built upon leased ground, Mr. J. G. Woodbury being the owner.

The hatchery at Sisson was also located upon leased ground belonging to Mr. J. H. Sisson. The Legislature of 1891 appropriated from the State's funds $500 to buy the ground upon which the hatchery is located. This purchase was made, and the deed for the same has been executed and duly recorded. As hereinbefore stated, when we took office there were no funds available for use in this department, and none could be obtained until the coming in of the appropriation for the forty-third fiscal year, which commenced on the 1st of July, 1891; however, we made a contract with Messrs. Stevens & McKenney, at Independence Lake, to take all the spawn they could hatch, at the price of $2 50 per thousand. They were not very successful in taking a large quantity of spawn, but without any fault on their part. They turned over to the Commission 88,000 fry, which were distributed by the Commission, as will appear by a report of the same hereto attached. No further attempts were made towards getting any spawn or fish until the fall run of salmon commenced, when we received from the United States Hatchery, located on the McCloud River, 2,850,000 eggs.

Mr. J. A. Richardson was appointed by the Board Superintendent of the Sisson Hatchery, and the work of hatching the salmon spawn received from the Government was turned over to him.

The Commission, early appreciating the necessity of having a hatchery in the vicinity of San Francisco, soon after the coming in of the appropriation for the forty-third fiscal year set about to see what could be done towards the accomplishment of that purpose. All the waters of San Mateo, San Francisco, Alameda, and Marin Counties were carefully examined, and finally, Bear Valley, in Marin County, was selected as the site for the new hatchery. The use of the waters of a small mountain stream which empties into Bear Valley Creek, with the right to construct a dam and reservoir, and also ground of sufficient quantity for the purposes of the hatchery, was obtained from Hon. Charles Webb Howard, the owner of the property, and he has given to the Commission a lease for five years, with the privilege of five additional, at a nominal rent of $1 per year. Having selected the site, the Commission set to work in August to build the hatchery.

We beg particularly to call your attention to the expense account in the construction of the hatchery. All of the lumber, with the exception of the shingles and the underpinning, which are of redwood, was a donation and a gift by the late Hon. James McM. Shafter. The building itself is a one-story, peaked roof, 40 feet in length by 22 feet in width, and can accommodate 24 12-foot troughs, with a capacity of hatching 1,000,000 eggs. At the present time, however, the Commissioners have in operation only 12 troughs, but expect to put in the other 12 shortly. The water used in the building is taken from a reservoir some 300 feet distant from the building. The dam is about 4 feet high, and is made of concrete. Ever since its construction, and up to the present time, the hatchery has been in constant operation, as will be seen by tables attached hereto.

We have proven conclusively the usefulness and perfect success of this hatchery. About the time of its completion the Commission appointed Mr. Eugene W. Hunt Superintendent of it, and he immediately took charge, and has been in charge ever since. The result of his work is fully set forth in reports and tables hereto attached.

Having failed to procure any trout spawn in the spring of 1891 for the above reasons, the Commission set to work to see what could be done in the matter of obtaining the spawn of the Eastern Brook trout. Application was made to the United States Fish Commissioner, but he was unable to supply us with any. We then placed ourselves in communication with Hon. George T. Mills, Fish Commissioner for the State of Nevada, asking permission to coöperate with him in procuring spawn of the Eastern Brook trout from Marlette Lake, State of Nevada. These negotiations culminated in an arrangement being made between Mr. Mills and this Commission by which each Commission gave the services of one of its deputies, the two Commissions dividing all of the expenses incident to the taking and eyeing of the spawn. By this arrangement, as will be seen by tables and reports hereto attached, we were enabled to distribute 317,000 fry. This arrangement with Mr. Mills was a very generous one on his part, and it is due to him that we should express in this report our appreciation of it. Immediately upon the completion of the distribution of the Eastern Brook trout so obtained, the taking and eyeing of Rainbow trout spawn from the Klamath River was commenced. The bulk of the spawn taken was sent to the Bear Valley Hatchery, and. as will be seen by tables hereto attached, resulted in the distribution of 331,000 Rainbow trout. That work has just been completed. At the present time we have made no definite arrangements with Mr. Mills to secure Eastern Brook trout eggs this fall, but we feel confident that some efficient plan will be made.

The Commission has not used the hatchery at Lake Tahoe for general work, that is, the hatching of spawn for general distribution, as we have concluded in was impracticable, principally for the reason of its long distance from any means of transportation by rail, and for the further reason that it cannot be made available in the winter on account of the snow and ice. It was this fact which prompted the Commission to construct the new hatchery at Bear Valley. As before suggested, and as is apparent from the tables and the reports attached, the Bear Valley Hatchery being located within so short a distance of railroad, and being near the central point for general distribution, is thoroughly practicable. It is not the present intention of the Commission to abandon the hatchery at Lake Tahoe; but we do not think it can be made use of, considering the small amount of the appropriation, for any purpose, other than the taking and hatching of spawn for Lake Tahoe and vicinity. We beg to call your attention to the tables hereto attached showing the places where trout have been planted. It will be noticed that some of the points are at long distances from railroad, but the distribution in all cases has been successful, and the planting has been attended with extremely small loss.

Mr. W. H. Shebley was appointed a deputy to assist the Superintendents of the Bear Valley and Sisson Hatcheries in the distribution of fish. Since that date he has practically had the entire management of that branch of the work.

Apropos of this subject, the Commission desire to express their gratefulness for the many favors which have been granted to it by all of the various railroad companies in the State, in furnishing transportation to our assistants, and the giving to them of the use of the baggage cars for the transportation of the fish and apparatus.

Without this aid the work of the Commission would have been very much handicapped, and we take great gratification in pointing to this assistance as one of the many courtesies we have received from every class of citizens of our State with which we have come in contact. There seems to be a broader and more liberal appreciation of the work of the Commission in all directions, and from every locality.

Whenever our deputies have proceeded with young fish to deposit them in remote streams, they have been invariably met by enthusiastic citizens only too willing to lend their time and labor to the successful transplanting of the young fry.

The Commission is under many obligations to Dr. David Starr Jordan, President of the Leland Stanford, Jr., University, and we take this opportunity to express our gratitude to him for the interest that he has taken in the work of the Commission, and in supplying us with scientific information, some of which has been embodied in bulletins hereto attached. He has at all times cheerfully responded to all requests that the Commission and its assistants have made.

We beg to call your attention to Dr. Jordan's description of the Golden trout and of a new species of salmon, as well as the drawings of both, which have been furnished to us by him, and with his permission we now publish for the first time. We also desire to express our thanks to Col. Marshall McDonald, United States Commissioner of Fisheries, for many courtesies we have received at his hands in supplying us with salmon spawn, and in sending to us bulletins and publications pertaining to his department.

A SEPARATE HATCHERY FOR YOSEMITE VALLEY AND SURROUNDING TERRITORY.

We earnestly recommend the construction of a hatchery in Yosemite Valley, to be placed under the control and expense of the Yosemite Commissioners. There is a large demand for trout fry from that section of the State, but it is impracticable for the State Commission, on account of the long distances of transportation, to stock those waters. If, however, a hatchery is built by the Yosemite Commissioners, we can always furnish the spawn. The expense of such a hatchery would be only a few hundred dollars.

NECESSITY FOR INCREASED APPROPRIATION IN THIS DEPARTMENT.

Upon reading the above report, we are of the opinion that you will perceive the necessity of an increase of $5,000 per annum in the appropriation for the Hatchery Department. We are hardly able to reach the remote portions of the State under our present appropriation; besides this, the wants of the State are enlarging with the increase in population. It is but the natural development of the situation. We therefore ask that the appropriation of the Hatchery Department shall be $10,000 per annum, instead of $5,000.

GAME AND FISH LAWS.

The Commissioners beg to recommend that certain changes be made in the fish and game laws of this State, and in particular as follows:

First—The sum of $20,000 per annum should be appropriated for the restoration and preservation of fish, which includes the Patrol Department. With this sum the entire State can be properly and efficiently patrolled by competent deputies, who will enforce and protect the game and fish laws. If you will consider the vast territory under our jurisdiction, this amount will appear to be a very moderate one. In the several Atlantic States extending from Maine to North Carolina, and covering an area in their entire extent less than that of our own State, the combined appropriation per annum for these purposes runs up to over $100,000; besides, on the Atlantic seaboard there is in that limited territory about twenty million of population, who watch each other and report to the authorities depredations and violations of the fish and game laws. We have about one million of people, but just as many fish and as much game to protect as the Eastern territory has with its enormous population. It is for these reasons we suggest this increase in our funds, and earnestly urge that your Excellency will present our claims for the increase to the coming Legislature.

Second—The law should be so changed as to make possession of any fish or game at a time when it is unlawful to take or kill the same, a misdemeanor, without regard to where the fish or game were taken or killed. As the law now stands, it is claimed that fish or game may be brought into this State from another State, when it is lawful in the other State to take or kill the same, although at the same time it is unlawful to take or kill in this State.

Third—The cold storage system is a matter which demands serious consideration. By this system it is practicable to place in storage either fish or game, taken at a time when it is lawful, and keep them for sale at a time when it is unlawful to take them. By this system it is entirely practical to supply fish and game out of season, and to make a market for both fish and game much in excess of the natural demand for the same during the open season. It is apparent that unless some restrictions and limitations are imposed, it will only be a matter of comparatively a short time when close seasons for fish and game will cease to accomplish any purpose.

Fourth—The close season for salmon should include the month of August, as well as September. In support of this recommendation we beg to call your attention to a letter written by George B. Williams, Jr., Superintendent of the United States Hatchery on the McCloud River, which was embodied in the biennial report of our predecessors for the years 1888 and 1890, and which we republish:

Baird, Cal., July 8, 1890.

Mr. J. G. Woodbury, *San Francisco:*

Dear Mr. Woodbury: Yours of the 5th at hand. Two years of experience in charge of this station on the McCloud has convinced me that unless some action is taken by the Legislature and those interested in the propagation of salmon as a food fish, to include the month of August as well as that of September in the close season, not many years will elapse when this valuable food fish will become almost extinct.

On account of the high water we are liable to have at this point during the spring and late fall runs, it is impracticable to secure and spawn by artificial methods the parent fish; but the August run comes at a time when it can be handled successfully. In order to allow this run to reach the headwaters of the Sacramento River, and its tributaries, the months of August and September should be reserved to allow a free passage of salmon.

I draw my conclusions from the fact that in previous years, when there was no fishing with seines in the Sacramento to speak of, thousands of salmon collected here during the latter part of August and during the month of September, and we found no difficulty in securing all the eggs we could handle, 14,000,000 ova having been taken in one season. From the August run in 1888 but 1,568,600 were secured, and in 1889, 1,105,000 were taken. In 1888 the season's take was increased to 5,584,600, by securing ova from the late run in October and November. But this was something unusual, and could not have been accomplished had it not been that the rains did not set in until December of that year. An attempt was made in 1889 to take the late run, but rains in October caused the McCloud to become very high, and racks and dams were washed out, allowing the parent fish to ascend the river and small creeks above the station.

It is very hard to decide how long it takes the salmon to reach their spawning grounds after they leave the seining grounds of the lower Sacramento, but as near as we can tell, from two to three weeks.

As you know, the work done at this station is almost entirely for the State. It seems as if it should be the aim of the people to do all in their power to aid the United States Fish Commission to accomplish its object by making laws that will protect this valuable food fish.

Much more could be said regarding the tremendous decrease in late years of the salmon, but I think I have advanced sufficient reasons to show that a longer close season is necessary to make a success of our work. It is a question that should be seriously considered and acted upon at once.

Yours truly,

GEO. B. WILLIAMS, Jr.,
Superintendent of Station.

Section 635 of the Penal Code should be amended so as to make it a misdemeanor to dump shavings into waters.

Fifth—Your attention is called to Section 636 of the Penal Code. As it now reads it is meaningless. The word "fish" in some manner was omitted.

The last section referred to should also be amended so that the possession of the young of any fish, either fresh or dried, be made a misdemeanor.

The same section should be further amended by eliminating therefrom the words "except Brook trout."

Sixth—The Board of Fish Commissioners should be given the right at any time to take any kind of game for propagating purposes.

Seventh—There should be legislation requiring ditch owners to place wire screens at the entrance of the ditches.

Eighth—We beg to call your attention to the fact that game birds are being introduced into this State from other countries, such as pheasants and wild turkeys. The Legislature should make it a misdemeanor to hunt, take, or have in possession any of this game for some period of time, say four years.

Ninth—An increase in the appropriation for the Hatchery Department from $5,000 per annum to $10,000 per annum.

Tenth—We recommend that a tax of 4 cents per case be placed and collected upon canned salmon. This Commission is hatching and planting about 3,000,000 salmon each year in the waters of our State. A small tax of 4 cents per case (which contains four dozen one-pound cans, or, which is the same thing, two dozen two-pound cans) would be willingly paid, we believe, by all persons engaged in this industry, and the revenue to the Hatchery Department of the Commission would be greatly augmented.

DEEP SEA FISHING.

Up to the present time no direct attempt has been made to investigate the extent of the marine fishing banks lying at the outer edge of the Golden Gate and along the coast of our State. On the Atlantic Coast this has become the most important department of the labors of the United States Fish Commission and of the various State Commissions. The number and variety of our marine fishes are supposed to equal, if not exceed, any other locality of equal area on the globe. To properly classify this, and to adopt any of the systems for the spawning and hatching of marine fishes, now so successfully being carried on on the Atlantic seaboard, will require a separate appropriation. The United States Fish Commission has for many years recognized the great importance of our seacoast for these purposes. The United States steamship "Albatross," Capt. Z. L. Tanner commanding, has, ever since the summer of 1888, been constantly along the Pacific Coast, and the reports made by him and his experienced officers and specialists upon the variety and diversity of our marine food fishes, form the most interesting portions of the United States Fish Commission reports for the last three or four years.

We respectfully recommend that the importance of this department of our labors be thoroughly investigated and understood by the forthcoming Legislature, and a sufficient sum allowed by law to not only assist the work of the United States Commission, but to obtain for our benefit a knowledge of the great marine wealth that lines our coast for over seven hundred miles in extent.

Herewith we proceed to present the reports in detail of our expenditures in the various departments, and also the reports of our several deputies, all of which will be found to proceed in conformity to the statements made in our own report.

Respectfully submitted.

JOSEPH D. REDDING,
President.
RAMON E. WILSON,
Secretary.
JOSEPH MORIZIO,
Treasurer.

CROSSCUP & WEST ENG. CO.
PHILA. PA.

Bear Valley Hatchery,—Olema, Marin Co.

EXTRACTS FROM REPORTS OF DEPUTIES.

Under the organization of the departments of the Commission, orders were given to each one of the deputies to file a weekly report with the Board, covering their actions and doings for that time. Such reports have been filed with the Board every week since its organization. A great many of them are of a confidential nature, partaking of detective work, and we do not think it advisable to publish them in full. They are, of course, open at all times to the inspection of the proper State officials. They show exactly where each and all of our deputies were upon every day since they have been in our employ, and are complete records of the work of the Patrol and Hatchery Departments during that time.

REPORT OF THOMAS TUNSTEAD.

[Under date of July 29, 1891.]

We visited every fishing camp on the Sacramento River from Nicolaus to Vallejo, a distance of about one hundred and fifty miles, and found the salmon run very small. At Feather River and vicinity I saw about one hundred fike nets, but they were not in use. These nets, when in use, are a permanent contrivance, which is a misdemeanor. We have no authority under the law to seize these nets. Of the men that I arrested on the 16th for extending their nets more than one third across the river, two were fined $50 each, and in the cases of the other two the jury disagreed, and upon the advice of the District Attorney, I consented to the dismissal of their cases.

[Under date of August 26, 1891.]

I started on the 28th to San Pablo Bay in search of Chinese, in company with Deputy Babcock. We saw a number of boats on the drift, but they were not working, and they did not work during the thirty-six hours that we lay at anchor in plain view of them.

[Under date of September 29, 1892.]

Visited Belmont, San Mateo County, investigating the reports concerning the trapping of quail, and in company with Mr. Lindsey, the local deputy, I visited the following places: Spanish Town, or Halfmoon Bay, Wrights Creek, Purisima Creek, San Gregorio, Lobitas, Corte Madera, Tornitas, Pescadero, Yazzos, Buteno, White Creek, New Year Creek, and Wardell Creek. We found and destroyed a number of traps at these places, but could not find the persons who set them. At one ranch we found a number of live quail, which the people claimed they had hatched. We released the birds but made no arrests.

At Wardell Creek we made the acquaintance of a former deputy. He reported that he had made a number of arrests in his district while he was connected with the Board, and had prosecuted the cases. Afterwards his store and barns were burned down, and he said that he then resigned from the Commission.

[Under date of January 11, 1892.]

I have to report that on January 4th I went to Cazadero, taking Deputy Babcock with me. We remained there over night. Tuesday morning we went to Duncan's Mills by train, and from there walked to the mouth of Russian River, some six miles. We were dressed as hunters and were accompanied by two dogs. About one mile from the mouth of the river we found a set net placed in the stream; it was fastened at one end to a stake, the other end being anchored in the stream some sixty yards from the shore. We remained in sight of this net for some two hours, when we saw two men come from a cabin near the net, get into a boat and take up the net. We were within four hundred yards of them at the time, and could plainly see what they did; they caught two salmon. After they had replaced the net in the water again we arrested them, taking them to Duncan's Mills on foot, and from there to Guerneville by wagon. We arrived there at 5 P. M. and took them before Justice Bartley, and preferred the charge against them of using a set net. They pleaded not guilty and demanded a jury, and the trial was set for the following Thursday. They were placed in the hands of the Constable. That evening at about 7 o'clock, the hotel at which we stopped was surrounded by a howling mob of men and boys, who blew fish horns and gave many other evidences of their disapproval of our actions; the disturbance was brought even into the public sitting-room of the hotel in which we were. We were told by a number of men about the place that we could never convict the men or any person or persons in that neighborhood of illegal fishing; that it was too general, and public sentiment was opposed to the law. Wednesday evening Assistant Prosecuting Attorney Luppo, of Sonoma County, came from Santa Rosa to take up our case. He informed us that he thought we had made a mistake in preferring the charges in Guerneville, as conviction there was almost impossible, but that our case was so very strong he hoped we might do so.

The trial came off Thursday. The jury was composed of middle-aged men. One of the defendants admitted, on cross-examination, that he fastened the net at 5:30 A. M. Tuesday to a post which was securely driven into the bank of the river, and that while the net was so fastened they caught two salmon. The other defendant claimed that he did not know whether the net was fastened to the stake or not while they were fishing. The Justice, at the written suggestion of the prosecuting attorney, instructed the jury to the effect that if they found from the evidence that either of the defendants fastened or assisted to fasten either end of the net to any stationary object, it is constituted a set net, and they must find the defendants guilty, etc. The jury was only out of the room some ten minutes, when they returned a verdict of not guilty. From the court-room to the hotel, and from the hotel to the station, we were followed by a howling mob of thirty or forty men and boys. It was a most insulting demonstration. Attorney Luppo and Superintendent Korberly of the San Francisco and North Pacific Railroad, who came away with us on the train, denounced the affair as being the most disgraceful of anything they had ever witnessed, and they did not believe such a demonstration could take place in any American town.

[Under date of February 1, 1892.]

We drove along the coast of San Mateo County, and spent several days in the vicinity. The waters were full of Steel-heads, but none are being killed contrary to the law, so far as we could find out. The stories one gets from San Gregorio and Pescadero are without number, but we could not get any evidence to substantiate any one of them; though we visited and talked with all of the people in the vicinity for two days, few of them knew our business. * * *

Deputy Lindsey, of Belmont, has been of great service to the Commission, in my opinion, by having posted Bulletins Nos. 1–3 throughout his district. All the people in the coast country seem to be posted upon the Steel-head, and are very shy of killing them. We found no foundation for any of the deer stories, and believe them to be without fact.

[Under date of February 29, 1892.]

This endless patrol of the markets goes on each day, and it is very necessary, but it is almost always without results. Since I have been in the employ of the Fish Commission the markets of the city of San Francisco have been visited every day by some one of the deputies in your employ, and the patrol of these markets I consider to be very complete. In this way we have destroyed the market for illegally caught game or fish. * * *

The almost entire absence of public sentiment for the enforcement of the fish laws in such places as Glen Ellen, Napa, and other well-known localities is most marked, so that the local aid the Commission may expect in these places is but slight.

[Under date of May 6, 1892.]

On April 15th, accompanied by Deputies Babcock and Koppitz, I went to the Sacramento River to make the annual spring examination and collect licenses. On the way up we overhauled and arrested eight Chinese fishermen for catching the young fish with set nets. We took the men to San Rafael, and resumed the trip, visiting Vallejo, Martinez, Benicia, Antioch, Collinsville, Rio Vista, and Sacramento, besides all the islands and sloughs on the way up the river.

On April 22d we arrested a Greek for fishing with a 5-inch-mesh net. He plead guilty at Martinez, and paid a fine of $50.

On April 26th we arrested four men below Rio Vista for having their nets more than one third across the width of the river. The local sentiment is strongly against the law, and a conviction is doubtful.

We finished the trip and returned to the city on May 5th. We collected some two hundred and ten licenses, a report of which is made to the Board by Deputy Koppitz. The spring run of salmon is light. The canneries are not open on the river, and the prospects of their opening is poor. The necessity of the close season in the spring, of at least one month, seems to me very necessary if the salmon are to be preserved to the waters of the Sacramento River. The number of boats engaged in the fishing grows less each year, and the men engaged in the business have a hard struggle for existence. The Saturday and Sunday close season is well observed, but does the salmon run but little good, as it is not long enough to let the fish pass up that part of Suisun Bay and the river covered by the fatal seines. A close season in April and September would be of much greater benefit to the fish, and would help materially to prevent their destruction. There cannot be too much effort made to have such a close season established. The launch that we used worked well most of the time.

[Under date of May 11, 1892.]

Went to Rio Vista, taking Deputy Babcock with me, to look after the fishermen arrested on April 25th. The defense put in a demurrer that the Code did not cover the case. The demurrer was sustained. It is the old question of "every person who shall cast, extend, or set any seine or net of any kind for the catching of," the word "fish" being omitted from Section 636. This section should be amended, as it is meaningless, owing to the omission of the word "fish."

[Under date of June 17, 1892.]

Taking Deputy Babcock with me, I went to Belmont, where we were joined by Deputy Lindsey. We took a boat from Belmont to the Morgan Oyster Co.'s camp at the mouth of the slough, and we sailed from there in one of the company's oyster boats, dressed as fishermen, and overhauled the Chinese at South Belmont. Their catch was free of fish, and the shrimps were the smallest I have seen. From South Belmont we sailed to the mouth of Redwood City Slough, and overhauled the two boats of the Quan Man Lee & Co., and arrested the ten men, as their catch was fully one third small fish. The head man, Ah One, offered Babcock and myself the money they would have to pay if fined, and used every endeavor to get us to take the money and let them go. We took them before Justice Welch, who held them to answer.

[Under date of June 29, 1892.]

With Deputy Babcock in the launch "Rustler," we went to Hunter's Point and overhauled the Chinese camp. We overhauled one junk on the bay that had Chinese sturgeon lines and sturgeon freshly caught. There were three men in the boat. I left the launch and took the Chinamen to Pacific Wharf in their own junk. * * *

I would suggest that the Commission request the next Legislature to pass a law prohibiting the catching of shrimps in set nets, and also prohibiting the catching of shrimps for the purpose of drying, and prohibiting the shipping, having in possession, or offering for sale, or exporting any dried shrimps.

[Under date of July 1, 1892.]

Upon several occasions your honorable Board has requested a more detailed report of my visits to the markets. It is, however, a rather monotonous form to give the names of all the stalls visited each week. I visit them all, each morning or during the day when I am in the city, and have found no violation of the law in any of them for months. The work is very necessary and is carefully done, and I am unable to give any facts or information from these visits, other than to report that the law, so far as the dealers are concerned, is observed. I cannot arrest any of the dealers because they have sturgeon that have been caught with Chinese sturgeon lines. The law does not cover the offering for sale of any such fish. I hope, therefore, that you will not hold me as being indifferent to your instructions that I did not mention the name of each stall each week.

[Under date of July 2, 1892.]

I accompanied Deputy Koppitz to Harbor View for the purpose of collecting licenses from fishermen at that point. We had very poor success, as many of them refused to pay, and dared us to make an arrest. We arrested five men, and locked them up, with the charge of fishing without a license. They gave bail to appear on the 5th, and on paying their licenses they were discharged.

Mr. Koppitz reports that since then he has collected from all the fishermen at that place without trouble.

[Under date of July 13, 1892.]

Accompanied by Deputy Babcock we went down the bay and arrested two Chinamen who were catching sturgeon with sturgeon lines, and took them to Redwood City to await trial. Their cases come up at San Mateo on the 22d. We have made almost weekly trips to the Chinese shrimp-fishing stations during the season of 1891–92, and the constant howl that we do not enforce the law as regards the Chinese, is done for some other purpose than is apparent upon the surface. These camps are regularly and systematically overhauled, and all that we can do with the means at our hands is being done, to see that they do not destroy the young of fish. The drying beds at all these camps are mostly free of small fish. I do not believe that the law is violated to the extent that is complained of.

[Under date of August 29, 1892.]

We took up a lot of sturgeon lines at Roe Island, Suisun Bay, and ordered the Italians who run the camp to move away. We could not arrest these men, as we could not catch them in the act of using the lines. We have taken no less than four miles of line and twelve anchors from these men during the year, so that their business cannot have been very profitable to them.

REPORT OF JOHN P. BABCOCK.

[Under date of July 13, 1891.]

I went to Port Reyes on July 7th, as directed. I saw Mr. ———; he repeated to me the story that he had told to Mr. ———, and gave me so good a description of the Swiss that he saw with the deer on July 1st, that I had but a few hours' search before locating the man at Millerton. I took Mr. ——— there to identify him, but he failed to do so, though he admitted the man answered the description to a nicety. I am fully convinced that "the little sawed-off Swiss, with small, black eyes, and a long, black-haired mustache so thin that you can see all of his upper lip," is the man at Millerton, and that ——— did not want to identify him, for fear that the large Swiss element in the neighborhood would resent his information and burn his valuable property.

[Under date of August 17, 1891.]

Mr. Storey, of Chip's Island cannery, told us that he would pay the orders given on him by fishermen who had any money due them; that the last spring run of salmon had been the poorest in his experience for years; that most of the fishermen quit in the spring in his debt, and that the poor fellows had not made their salt during the summer; that he would not open the cannery for salmon until the last week in August, unless the run of fish was strong.

[Under date of August 26, 1891.]

It is needless for me to add that the license-collecting trip on the Sacramento River should be made early in April, during the spring run, and pressed to a finish. The fall run is too short and uncertain.

[Under date of October 9, 1891.]

I went to Santa Cruz. Left the train at Rincon and went down to the California Powderworks, on the San Lorenzo River, and in company with Mr. W. C. Payton, Superintendent, went over the company's dams, flumes, and tunnel. They take all the water from the river and carry it for a mile or more in flumes before it is again returned to the river, leaving the bed of the stream dry at this season of the year for at least a mile and a half. During the winter there is plenty of water in the bed of the stream. The company has agreed to put in three ladders at points in their flumes that I selected. With the aid of these ladders, I believe that every ambitious fish can go around the break. I am pleased to find the matter so simple of solution.

[Under date of October 10, 1891.]

I went to Branceforte Creek and saw the Hihn Company dam. It is about twelve feet high and has plenty of water running over it, even at this time of the year, to support a ladder. I interviewed the manager of the company, and he agreed to put in a Commissioner's ladder.

[Under date of November 15, 1891.]

I visited the new hatchery at Bear Valley, and found the hatchery admirably located, a good, strong, and suitable building for its important purpose. Bear Valley Creek is an ideal stream, its waters being abundant, cool, and clear. It flows for its entire length over rocks and gravel, through a deep, closely wooded cañon. All persons familiar with its history say that it is always clear, subject to no floods, and in mid-winter rises but a foot or so. I gave the plans and drawings to Andrew, the carpenter, for the tanks and the troughs.

* * * * * * * *

I had a long talk with George Hall, of the McCloud River, during the week, and he says that the fishing on the McCloud River has never been so fine as this season; that he has not seen nor heard of any carp being in the upper waters of that most beautiful stream. He says that there has been no deer killed in his vicinity that he knows of, and that the laws have been well observed, and that there are no complaints from any one there; that he never saw the upper Sacramento so clear and fish so plentiful. There is no sawdust dumped in the Sacramento River.

[Under date of January 18, 1892.]

I overhauled the Chinese shrimp-fishing station at San Pedro Point. The fishermen are mostly idle at this season, as they cannot dry shrimp during the wet weather.

[Under date of February 15, 1892.]

I do not visit the markets at any regular time, so that the dealers may not expect me. There were a few Tahoe trout shown by ——— during the week, but they had been in cold storage since last season. They are shriveled and uninviting specimens, and trade in them cannot amount to much. The question of cold storage, however, may some time become a matter of great annoyance to the Board. * * * The only deer hides I found during the week were from Colorado. I took the address of the shipper, and have written the Colorado Game Commissioners, informing them that hides were being shipped into this State.

[Under date of February 29, 1892.]

Mr. George Denison, of Boulder Creek, called at headquarters this morning. He gives a fine report of the workings of the fish ladders in all the dams near his place. He says the Perry dam at Boulder Creek has a fine ladder that works well, and the one that he has put in his own dam was a success in every way; that he had seen hundreds of fish pass over it, and that he had never seen so many or such large fish in Boulder Creek.

[Under date of June 5, 1892.]

Went over the hatchery and buildings at Tahoe. Everything was in good order, save the nets, which the field mice seemed to have ruined. J. A. McKenney, of Tahoe City, made application to me for the use of the house and grounds connected with the hatchery. He agrees to take good care of the same, rent free. I would recommend that his request be granted.

[Under date of June 6, 1892.]

We visited the Pacific Lumber and Wood Company's Mill at Burkhalter Station. They have as fine a fish ladder in their dam as I saw anywhere in the Truckee River, and their arrangements for disposing of their sawdust are by far the best I have seen in the State. Their furnace and conveyors cost over $8,000.

[Under date of June 7, 1892.]

The Truckee Lumber Company have a bulkhead on the opposite side of the river from their mill, where they dump their sawdust. They claim to have spent $10,000 on it. It takes good care of all the sawdust from the mill, but the shavings from their door, sash, and blind factory are, however, all dumped into the river. I protested against this, and am in hopes that we may yet come to a satisfactory conclusion in the matter. The Legislature should be petitioned to prohibit the dumping of shavings as well as sawdust into streams of the State. * * *

The Sierra Nevada Sportsman Club, recently organized in Truckee, has a membership of over thirty. Stewart McKay is the President, and Wm. O'Neill is the Secretary, and all the local fishermen—not professionals—are members. They have printed notices of the fish and game laws stuck up all around the lakes and rivers in that vicinity, and seem to be organized for business.

[Under date of June 11, 1892.]

From the mill we drove to Griff's Creek, a tributary of Lake Tahoe. O'Neill had located an Indian fish trap on the creek several days before, but was in doubt as to his powers in the matter. We found the trap in place. It was a most ingenious contrivance for catching fish, made from woven green willows. The Indians who were working this engine of destruction for numberless spawn fish, were camped beside the creek. We ordered them to leave the lake and took out their trap. We worked over an hour and a half to get it out of the water. The Indians made no objection, as O'Neill told them that I was a Government man, and would put them in jail if they did not leave.

[Under date of June 16, 1892.]

This endless round of the markets each day is, of course, very necessary, but it has been without result for months, other than to keep them free from game and illegally caught fish.

[Under date of June 23, 1892.]

In the launch "Rustler," in company with a "Call" reporter, I visited the shrimp-fishing station at San Pedro. We overhauled some ten fishing junks. They were full of shrimp, but contained no small fish. The drying beds on the hillsides at this large station are without shrimp or fish. The "Call" man said I had proved to him that the Chinese could catch shrimp without taking small fish.

[Under date of June 29, 1892.]

I went to Hunter's Point in the launch "Rustler." We first overhauled a Chinese boat, with sturgeon lines and fresh sturgeon. Tunstead accompanied this junk to the city. After he left the launch I overhauled another junk, and arrested the five Chinese fishermen it contained for having caught the young of fish. After a good deal of a row, I landed them in the county jail in San Francisco. This is the first time that I have found at Hunter's Point Chinese with the young of fish in their boats.

[Under date of July 5, 1892.]

I called upon Mr. Smurr, of the Southern Pacific, and he assures me that the railroad will not move the deer skins for ———, or any one else, without a permit from the Commission. No such permit should be granted, as the position the railroad people have taken will be of great help to the Commission.

[Under date of July 21, 1892.]

Spent the day in the markets, and went to Harbor View. One may visit these places every day, and so long as there are no arrests to make one cannot do more than mention that the places were visited; from the fact that nothing else is reported, seems sufficient to cover our action. The market men know that some time during the day we will carefully inspect their stalls, and that knowledge has the desired effect.

[Under date of July 22, 1892.]

Went to San Mateo. The Chinamen were tried and convicted. Herald the fact that one jury has not shirked its duty.

[Under date of July 31, 1892.]

The month has been a good one for us. The number of convictions were larger than usual. I believe there can be no just fault found with the work that we have done, when one knows the extent of shore line and territory we have to patrol. The most effective thing that we can do, is to see that the sale of illegally killed fish or game is prevented, for by destroying the market we destroy the business.

[Under date of August 17, 1892.]

The improvement in the condition of the Truckee River is most marked, and when the factories cease dumping their shavings into the river, the Commission may feel satisfied over the situation here. Every one agrees that the fishing in the Truckee River was never so good. There are no dams in the Truckee River without good and efficient fishways, and no sawdust is dumped into the river.

REPORT OF W. H. SHEBLEY.

[Under date of January 6, 1892.]

We began receiving the Eastern Brook trout spawn from Carson on January 6th, and received shipments on the 15th and 23d, and on February 1st. The total amount of spawn received in the four shipments was 362,000. The total loss of transporting was 18,882, or an average loss per cent of .0521+.

All, or nearly all, of these eggs that became addled in transportation were unfertilized. * * *

As the spawn neared the period of hatching, quite a number of the eggs hatched out and died. The embryo would burst from the shell, or membrane, and die soon after. These were all organically weak, the result unquestionably of carrying the green spawn so far over the rough road. After the eggs were hatched there was an unusual number of malformed embryos in the troughs, the effect of the jolting the ova received on the way from the lake to Carson. Those embryos that came from the eggs in a healthy condition developed into fine healthy fish.

[Under date of April 4, 1892.]

We started for the San Gabriel River on the 29th and arrived on the evening of the 1st, after a continuous journey of over sixty hours. The fish arrived in good condition, considering the length of the trip and the smallness of the fish. We lost about two hundred and fifty, or about 1 per cent. They died from exhaustion. The length of time they were without food, and the continual motion of the water from the use of the aerators wears them out on such a long trip. The Eastern Brook trout should do well in the San Gabriel Cañon.

[Under date of June 13, 1892.]

I returned to Beswick to take charge of the work of securing ova during the remainder of the spawning season. I found that the spawn fish were not running any better than they were in March, when I left to commence distributing the fish from the Bear Valley Hatchery. Mr. Richardson had 29,600 eggs in the building, and 221 large fish—106 females and 115 males. He had them shut up in an impounding weir in the creek. I manipulated them and found that they were unripe, and would not mature for quite awhile. I changed them to a larger reservoir near the hatchery, where they would have more room and less chance to injure themselves in their efforts to escape. These fish were smaller, and in appearance different from those that we took last year. Those taken last year in the traps were ripe, or nearly so, and we did not have any difficulty in securing all the spawn that we wanted. From June 14th to July 1st we caught 388 fish—271 females and 117 males. There were more fish caught with rod and line, and put into this new reservoir, than we took with our trap. The number of fish caught and put in this pond during the interval from June 14th to July 1st was at least 500. With those Mr. Richardson had when I came, and those we caught in the trap, made a total of over 1,100. We manipulated these fish every few days, and only secured 53,600 ova.

The last time that we stripped the fish we took about 5,000 eggs. The females were healthy and in good condition, but the males were diseased and nearly spent. I did not count this lot of ova at all. The appearance and general condition of the fish this season showed plainly that they inhabited the river above the dam, and did not belong to the great run of fish that come from the ocean and the lower waters of the river during the spawning season. The fish ladder over the dam at Pokegama is too small for a river of the size of the Klamath.

REPORT OF E. W. HUNT.

[Under date of September 9, 1891.]

I left San Francisco for Independence Lake, where I was to accept the young trout hatched by Messrs. Stevens & McKenney for the Commission under contract. I arrived at the lake on the 10th at 2 P. M., met Messrs. Stevens & McKenney, and went to their camp at the head of the lake where their hatchery is situated; saw the young fish, which apparently looked in good condition and ready for distribution. Their hatchery is very nicely arranged under the circumstances. * * *

The water is supplied by several springs, and the average temperature while hatching was 48°, the coldest being 44° and the warmest 52°. They took about forty days to hatch. They took about 83,000 Idependence Lake spawn and 16,000 White Rock Lake spawn. The loss of the Independence was about 10 per cent and the White Rock about 5 per cent. The color of the White Rock spawn is a cherry red, about one quarter smaller than the Independence. The color of the Independence is lemon, and about the same size as the Tahoe and Donner spawn.

[Under date of September 12, 1891.]

I left Webber for the Fordyce Dam with Captain Burton, over the new road which has been completed at the head of the lake. We went to ascertain if it was possible to take spawn there. * * * There is no place on either shore of the lake where a seine could be hauled or the fish trapped.

[Under date of September 26, 1891.]

In pursuance to orders, I started for Carson to see Fish Commissioner Mills, of Nevada. I had a conversation with him about taking Eastern Brook trout spawn from Marlette Lake. He says that we could have one half of the spawn if the Commission would pay half of the expenses, and send one man to assist in obtaining it. He does not think it advisable to ship the green spawn to the Tahoe Hatchery, as we would take too many chances of losing it after the long trip it would have from the lake to Carson. He stated that it would be better to eye them at the Nevada Hatchery in Carson. This will take from forty to fifty days. By that time we can readily ship them to the Bear Valley Hatchery without injury. The Carson Hatchery has six troughs and twenty baskets, enough to eye 1,000,000 spawn.

[Under date of September 30, 1891.]

I have been making inquiries about the land-locked salmon planted in Donner and Independence Lakes. There have been two or three caught in Independence Lake during the spring and summer, weighing from 1½ to 3 pounds. The professional fishermen on the lake do not think that they hybridize. They are decreasing instead of increasing. None have ever been caught in Donner Lake that I can hear of. I have also made inquiries about the Eastern white fish in the Little Truckee River. No one seems to know anything about them. They say that some have been planted in the Truckee River, Prosser Creek, and Lake Tahoe. A great many of the fishermen say that the white fish caught in these waters are natives, and not the Eastern white fish. I did not know that they could distinguish the difference. These fish have been caught from small fry up to 2 pounds in weight in the Truckee River and in Lake Tahoe. * * *

They are catching Rainbow trout in the Truckee River, and all of the anglers say that these fish are the best and most game in the river.

[Under date of August 1, 1892.]

I would respectfully suggest to your honorable Board the necessity of building a cabin near the Bear Valley Hatchery before beginning work this fall. We lose from an hour to an hour and a half each day in coming from town to our work. The time thus lost is precious, for early in the morning and evening is the time young fish most like to feed. Another reason why the person in charge of the hatchery should live close to it, is the danger of an accident happening to the water supply. If anything should happen to the water the labor and expense of months may be lost in a very short space of time. I would also recommend that the hatchery be completed by putting in eight more hatching troughs before more spawn is put into the building. We are now in the middle of the dry season, and the water is as low as it will be. There is an ample supply of water to run this hatchery to the full capacity.

REPORT OF J. A. RICHARDSON.

[Under date of September 15, 1891.]

I arrived at the United States Fishery, and was met by George B. Williams, Deputy United States Fish Commissioner. Mr. Williams accompanied me over the works. He has made many improvements in the last two years. Everything is working perfectly, and the right man is in the right place. The mode of raising water from the river, by combining a current wheel and a centrifugal pump, works without danger or accident. There were 2,544,000 eggs in the hatchery. The temperature of the water was 53°. I watched the men seining in the evening. The salmon are not running very numerous, but are large in size, the females predominating 6 to 1. As fast as the salmon are caught they are put in corrals, where they get much scarred and battered trying to free themselves. There is no way to prevent this. They seine from 5 P. M. to 10 P. M., with one hour for dinner, and again from 5 A. M. to 8:30 A. M. The system of working is perfect. From three to fifteen is the average catch. Early in the season sometimes two hundred salmon are taken at one catch. The stripping does not commence until 9 A. M.; 140,000 eggs were taken from 31 fish, giving a total of 2,684,000 to date. The fish average large this season, 148,000 eggs from 31 fish, giving an average of 4,516 eggs. They have taken as many as 8,000 eggs from one fish this season. The smallest fish caught this season was a female, weighing 3½ pounds, and the largest weighed 40 pounds, and was a male. * * *

I saw a Leather carp in the reservoir by the house, which was one of two that were taken in the seine a few days ago, which would go to show that the carp are working up into the McCloud River.

[Under date of Beswick, May 17, 1892.]

The total number of trout eggs taken to date is 402,000. During this month a new run of trout have put in an appearance. We have about 100 on hand; they are slow in maturing. It will be from one to three weeks before the above have reached that condition. These trout are thick set and rather short, and are in good condition. They are highly colored, and especially is this the case with the fins. I have noticed a few specimens that were so highly colored that it seemed unnatural. The pectoral, ventral, and anal fins were bright scarlet, tipped with white. We are catching more angling than with the traps. Until about the 10th instant the males were very scarce, and even now only about one in ten is matured, although there are plenty of them. The season has been unusually cold and backward. Fly fishermen are taking from ten to twenty pounds of trout here a day. * * *

I think a great many trout ran up the creek last winter, for this reason: For the past two months spent trout have been coming down the creek, but could not pass the corrals or traps which extended entirely across the stream. These trout would collect in the pools above by the hundred, and would die if not allowed to return to the river. A narrow lane, or pass, one foot wide was built through the corral, or trap, connecting the creek above with that below, and in twenty-four hours scarcely a trout could be seen above in the creek.

These trout are silver-sided, long and slim, in good condition, but poor; the flesh is almost white. When collected in the pools above the trap they take the fly readily. The salmon fly are here by the thousand.

[Under date of Sisson, May 15, 1892.]

Hon. RAMON E. WILSON, *Secretary State Board of Fish Commissioners:*

SIR: I herewith transmit a statement of the salmon spawn hatched during the season of 1891–92:

These salmon eggs were received from Superintendent G. B. Williams, of the United States Fishery, on the McCloud River, with a per cent loss in shipping, as follows:

September 30, 1891	454,750.	Loss .018 per cent.
October 2, 1891	450,000.	Loss .02 per cent.
October 6, 1891	460,000.	Loss .025 per cent.
October 7, 1891	460,000.	Loss .03 per cent.
October 8, 1891	332,000.	Loss .015 per cent.
October 10, 1891	440,000.	Loss .02 per cent.
December 1, 1891	255,000.	Loss .033 per cent.

The entire shipment of salmon eggs was hatched at a loss of 7 per cent, or about 200,000 eggs (not fry). Regarding the loss of fry during the months of October and November, I selected four compartments at random from the forty compartments containing the same number, 70,000, of fry. The loss was as follows for each day in the six weeks: 200, 150, 50, 30, 65, 76, 176, 102, 120, 140, 155, 140, 125, 123, 35, 76, 54, 82, 90, 45, 33, 46, 54, 30, 25, 37, 73, 29, 70, 41, 29, 20, 18, 21, 27, 15, 30, 22, 12, 8, 21, 7; total, 2,800, or, for the forty compartments, 28,000, which is less than 1 per cent.

All of the fry in this loss were mostly malformations. You will notice that the loss gradually decreases from day to day to the end of the six weeks. The following six weeks I made a second test of the loss; every fifth day I made a careful count of the loss of the fry in all of the forty compartments, and found the loss to be 221.5 on an average for each day, or 9,303 for the six weeks.

This loss is less than one third of 1 per cent for these six weeks. This would give a loss of $1\frac{1}{3}$ per cent for the three months up to the time when we commenced to distribute the fry.

When we commenced to distribute the fry in the streams, and make the transfer to the nursery ponds, the number on hand was changing and diminishing every day, and it was difficult to get at the exact per cent loss, but it was much less than one half of 1 per cent for the remaining time, and I have allowed $1\frac{2}{3}$ per cent, which is more than the actual loss for that time, or a total loss of fry of about 3 per cent.

There never were over 500,000 fry in the nursery ponds at one time, as a few were allowed to escape each day, while others were added from time to time to make up the difference.

The fry in the nursery boxes are not so large as fry reared in the nursery ponds. The fry in the nursery boxes are never at rest from the constant current, which is gentle, but continuous. In the ponds they can seek still water to rest, which they will do a portion of the day. I made the first transfer of fry to the nursery ponds on November 30, 1891. The fry were transferred to the nursery ponds as follows:

1891—November 30	150,000
1892—February 4	50,000
February 15	50,000
February 18	50,000
February 20	80,000
February 24	20,000
February 27	20,000
February 29	80,000
March 2	20,000
March 4	72,000
March 5	50,000
March 6	24,000
March 7	50,000
1892—March 8	20,000
March 9	25,000
March 10	25,000
March 11	25,000
March 12	25,000
March 13	25,000
March 15	50,000
March 17	50,000
March 18	25,000
March 20	50,000
Total	1,036,000

After February 1st the screens of the nursery pond were removed for an hour each day, to allow a portion to escape into the creek. After March 10th the screens were removed entirely, which allowed the fry to escape at their pleasure. May 1st there were still 200,000 fry on hand at Sisson, the loss being from one to three per day. A careful count is being kept of the loss.

Salmon fry were distributed in creeks which are tributary to the Sacramento River, as follows:

1892—January 7—School House Creek	25,000
January 7—Sulloway Creek	70,000
January 3—"3" Creek	70,000
January 13—Cold Creek	70,000
January 14—Sulloway Creek	70,000
January 15—Stevens Creek	70,000
January 16—Sulloway Creek	70,000
January 17—Cold Creek	70,000
January 18—"3" Creek	70,000
January 20—Wagon Valley Creek	70,000
January 23—Stevens Creek	70,000
January 25—Sulloway Creek	70,000
January 26—Cold Creek	70,000
January 27—School House Creek	70,000
January 29—Sulloway Creek	70,000
January 30—"3" Creek and School House Creek	70,000
February 1—Wagon Valley Creek	70,000
February 2—Cold Creek	70,000
February 3—School House Creek	70,000
February 7—Root Creek	50,000
February 8—Little Castle Creek	50,000
February 10—Slatonis	50,000
February 13—Klamath River	60,000
February 16—Klamath River	60,000
February 19—Klamath River	60,000
Total	2,651,000

The above lot of fry were as fine a lot of fish as ever were turned out of any hatchery in the world. I have hatched over 24,000,000 salmon, and I think my judgment good in this matter. The eggs varied greatly in size this year; the average diameter was .307 of an inch, a 4-inch square containing 86. Many eggs of the second run were as small as trout eggs, being but .22 of an inch in diameter.

DIRECTORY OF DEPUTY PATROLMEN, STATE BOARD OF FISH COMMISSIONERS, WHO SERVED WITHOUT PAY.

William Lindsey	Belmont.
A. W. Scott	San Francisco.
E. A. Dakin	San Francisco.
H. H. Brittan	Stony Ford, Colusa County.
H. W. Smith	Placerville.
Thomas W. Hobson	San José.
Donald Ross	San Francisco.
Howard Black	Livermore.
S. H. Bolander	San Francisco.
James Hanley	San Francisco.
George McCrimmon	Oakland.
Victor Poncellett	New Almaden.
Alexander Murphy	Mountain View.
George Denison	Boulder Creek.
J. H. Mansfield	Spanishtown.
James Haynes	Marysville.
Wm. O'Neill	Truckee.
Trividio Trumbo	Santa Cruz.
F. G. Laird	Santa Cruz.
H. S. Loveland	Las Uvas.
Mason Bradfield	Filmore.
C. R. Woods	Selma.
Thomas A. Varian	Ferndale.
Charles F. Hargitt	Avalon.
Wm. Mossop	Olema.
A. C. Maude	Bakersfield.
George Bement, Jr.	Oakland.

DISTRIBUTION OF FISH BY THE STATE FISH COMMISSION.

DISTRIBUTION OF LAKE TAHOE TROUT FRY.

Distributed during the month of September, 1891.

Date.	Location.	Number of Fish.
1891.		
Sept. 19	Donner Creek, 2 miles west of Truckee	10,000
Sept. 19	Cold Stream, 7 miles southwest of Truckee	15,000
Sept. 21	Little Truckee River, 3½ miles from Webber Lake	25,000
Sept. 22	Mortis Creek, 3 miles southeast of Truckee	6,000
Sept. 22	Union Mill Creek, 9 miles east of Truckee	4,000
Sept. 23	Little Truckee River, 2 miles from Webber Lake	13,000
Sept. 23	Webber Lake (White Rock trout)	15,000
	Total	88,000

The spawn from which these fish were hatched was taken by Stevens & McKenney. under contract, and was hatched by them at Independence Lake in their own hatchery.

DISTRIBUTION OF EASTERN BROOK TROUT.

FROM BEAR VALLEY HATCHERY.

Date.	Location.	Number of Fish.
1892.		
April 1	Islips Creek, tributary San Gabriel River, Los Angeles County	2,500
April 1	Browns Cañon, tributary San Gabriel River, Los Angeles County	5,000
April 1	Persingers Gulch, tributary San Gabriel River, Los Angeles County	9,600
April 1	Creel Club Creek, tributary San Gabriel River, Los Angeles County	400
April 1	West Fork San Gabriel River, Los Angeles County	7,500
April 10	Garcia River and tributaries, Mendocino County	25,000
April 14	Olema Creek, Marin County	10,000
April 17	Austin Creek and tributaries, Sonoma County	25,000
April 22	Pescadero Creek, San Mateo County	13,000
April 22	Smith Creek, tributary to Pescadero Creek	3,000
April 22	Buteno Creek, San Mateo County	9,000
April 25	San Lorenzo River and tributaries, Santa Cruz County	30,000
April 26	Branceforte Creek, Santa Cruz County	7,000
April 26	San Lorenzo River, Santa Cruz County, below powderworks	7,000
April 26	Laguna Creek, Santa Cruz County	7,000
April 26	Soquel Creek, Santa Cruz County	14,000
April 30	Calaveras Creek, Santa Clara County	12,500
April 30	Austin Gulch, tributary Los Gatos Creek, Santa Clara County	12,500
May 4	San Antone Creek, tributary Calaveritas River, Calaveras County	25,000
May 12	Halleck Gulch, tributary Nicasio Creek, Marin County	6,000
May 14	San Vicente Creek, Santa Cruz County	3,500
May 14	Granite Creek, Santa Cruz County	3,500
May 14	Scott Creek, Santa Cruz County	7,000
May 14	Glen Cañon Creek, Santa Cruz County	3,500
May 14	Zayanto Creek	3,500
May 14	San Lorenzo River	14,000
May 16	Sulphur Creek, at confluence with Squaw Creek, Sonoma County	10,000
May 18	Pieta Creek, Sonoma County	10,000
May 21	Dry Creek, Placer County	6,000
May 21	Applegate Creek, Placer County	10,000
May 31	Golden Gate Park	5,000
May 31	Inman Creek and Adobe Creek, Sonoma County	10,000
	Total	317,000

The spawn from which these fish were hatched was taken jointly by the Nevada Fish Commission and this Board, from Marlette Lake, in Nevada.

DISTRIBUTION OF RAINBOW TROUT FRY.

From Bear Valley Hatchery.

Date.	Location.	Number of Fish.
1892.		
July 27	San Geronimo Creek, Marin County	12,500
July 27	Lagunitas Creek, Marin County	12,500
July 29	Cold Creek, Mendocino County, tributary Russian River	9,000
July 29	Reeves Creek, Mendocino County, tributary Russian River	6,000
July 29	Walker Creek, Mendocino County, tributary Russian River	10,000
July 29	Mark West Creek, Sonoma County, tributary Russian River	15,000
Aug. 3	Stevensons Creek, Fresno County, tributary San Joaquin River	45,000
Aug. 3	Rush Creek, Fresno County, tributary Kings River	5,000
Aug. 9	Limekiln Creek, Santa Clara County	9,000
Aug. 9	Guadalupe Creek, South Fork, Santa Clara County	13,000
Aug. 9	Guadalupe Creek, West Fork, Santa Clara County	3,000
Aug. 9	Guadalupe Creek, main branch, Santa Clara County	7,000
Aug. 9	Montoyo Creek, Santa Clara County	3,000
Aug. 12	Corta Madera Creek, San Mateo County	9,000
Aug. 12	Tornitas Creek, San Mateo County	6,000
Aug. 12	Purisima Creek, San Mateo County	10,000
Aug. 16	Napa Creek, Napa County	7,000
Aug. 16	Milliken Creek, Napa County	6,000
Aug. 16	Hinchica Creek, Napa County	6,000
Aug. 16	Dry Creek, Napa County	3,000
Aug. 16	Reeta Creek, Napa County	3,000
Aug. 18	Santa Ysabella Creek, San Luis Obispo County	25,000
Aug. 22	Santa Rosa Creek, Sonoma County	15,000
Aug. 22	Lynch Creek, Sonoma County	6,000
Aug. 22	Carson Creek, branch of Paper Mill Creek, Marin County	7,500
Aug. 25	Dry Creek, Sonoma County	12,000
Aug. 25	Little Sulphur Creek	10,500
Aug. 26	San Gregorio Creek, San Mateo County	10,000
Aug. 28	Squaw Creek, Placer County, tributary Truckee River	5,000
Aug. 29	Scott Creek, Placer County, tributary Truckee River	5,000
Aug. 29	Deep Creek, Placer County, tributary Truckee River	5,000
Aug. 29	Cold Creek, Nevada County, tributary Truckee River	5,000
Aug. 29	Cold Creek, Nevada County	2,500
Aug. 29	Martins Creek, Nevada County	2,500
Aug. 30	Alder Creek, Marin County	2,500
Aug. 30	Ness Creek, Marin County	2,500
Sept. 1	Mill Valley Lake, Fresno County, tributary Kings River	25,000
	Total	331,000

The spawn from which these fish were hatched was taken from Shovel Creek, Siskiyou County, California.

DISTRIBUTION OF RAINBOW TROUT.

FROM SISSON HATCHERY.

Date.	Location.	Number of Fish.
1892.		
May 30	Shovel Creek, Siskiyou County	10,000
Aug. 4	Cold Creek, Siskiyou County	500
Aug. 5	Soda Creek, Castle Crag, Siskiyou County	20,000
Aug. 5	Cache Creek, Capay Valley	20,000
Aug. 12	Placerville, tributary American River	20,000
Aug. 24	Squaw and Bear Creek, tributary Truckee River	25,000
Aug. 29	North Fork American River, above upper falls	25,000
Sept. 6	Golden Gate Park	4,600
Sept. 8	Bridal Veil Creek, above Yosemite Valley	1,700
Sept. 8	Illillonthe Creek, seven miles from Yosemite Valley	1,700
Sept. 9	Ostromder Lake, twelve miles from Yosemite Valley	6,800
Sept. 9	Rush Creek, tributary South Fork Merced River	1,700
Sept. 9	Laurel Creek, tributary South Fork Merced River	1,700
Sept. 9	Wawona Creek, tributary South Fork Merced River	3,400
Sept. 9	Chilualno Creek, tributary South Fork Merced River	3,400
Sept. 9	Soda Creek, tributary Sacramento River	25,000
Sept. 11	Scott Creek, Mt. Shasta	5,000
	Total	175,500

The spawn from which these fish were hatched was taken from Shovel Creek, Siskiyou County, California.

TEMPERATURE OF WATER.

IN BEAR VALLEY HATCHERY—SEASON OF 1892.

Month.	Lowest.	Highest.	Mean.
January	35°	50°	41½°
February	42	53	47½
March	46	54	50
April	46	53	48
May	49	58	53
June	49	58	53½
July	52	59	53
August	53	60	56½

IN SISSON HATCHERY—SEASON OF 1892.

Month.	Lowest.	Highest.	Mean.
January	40°	47°	43½°
February	44	49	44½
March	40	52	46
April	40	52	46
May	40	57	48½
June	42	57	49½
July	43	56	50
August	44	55	50

FINANCIAL STATEMENT.

RESTORATION AND PRESERVATION FUND.

Expenditures during Forty-second Fiscal Year, ending June 30, 1891, Chargeable against the Appropriation for Restoration and Preservation of Fish in the Waters of the State.

Appropriation March 21, 1889		$5,000 00
Warrant No. 443.—M. J. O'Reilly	$1 00	
No. 478—J. Routier	30 00	
No. 1621—W. S. Harris	147 80	
No. 1623—Perkins & Stevens	1 05	
No. 1624—J. A. Richardson	119 65	
No. 1625—M. J. O'Reilly	30 00	
No. 1626—Tug "Roberts"	52 00	
No. 1628—J. D. Ennis	159 25	
No. 1629—J. D. Harvey	9 00	
No. 1630—J. Routier	30 00	
No. 1817—F. P. Callandun	115 60	
No. 2581—F. P. Callandun	147 60	
No. 2582—M. J. O'Reilly	30 00	
No. 2583—W. S. Harris	140 50	
No. 2599—J. D. Harvey	5 00	
No. 2600—J. Routier	30 00	
No. 2601—J. D. Ennis	135 00	
No. 2602—Wells, Fargo & Co.	75	
No. 3872—Wells, Fargo & Co.	1 05	
No. 3870—W. S. Harris	100 00	
No. 3871—W. S. Harris	37 50	
No. 3873—M. J. O'Reilly	30 00	
No. 3874—F. P. Callandun	179 80	
No. 3874—J. D. Ennis	146 50	
No. 4701—W. S. Harris	100 00	
No. 4720—W. S. Harris	48 40	
No. 4723—M. J. O'Reilly	30 00	
No. 4724—F. P. Callandun	195 85	
No. 5085—Perkins & Stevens	70	
No. 5086—J. Routier	61 00	
No. 5087—J. D. Ennis	144 15	
No. 5088—Britton & Rey	75 00	
No. 3856—F. P. Callandun	129 00	
No. 5837—M. J. O'Reilly	30 00	
No. 5838—J. L. Curley	10 00	
No. 5948—W. S. Harris	100 00	
No. 5960—W. S. Harris	43 90	
No. 5978—J. D. Ennis	137 00	
No. 5979—W. S. Schittger	5 00	
No. 5980—J. Routier	30 90	
No. 6579—J. F. Curley	20 00	
No. 8034—F. P. Callandun	136 50	
No. 10376—J. M. O'Reilly	30 00	
No. 11642—J. D. Ennis	140 50	
No. 12575—F. P. Callandun	130 50	
No. 13302—J. F. Curley	15 00	
The above bills were approved by the previous Board, and paid out of the appropriation for the forty-second fiscal year.		
No. 13303—F. P. Callandun	136 45	
No. 13747—J. D. Ennis	306 00	
No. 14915—M. J. O'Reilly	93 00	
No. 14934—J. W. Hartley	34 00	
No. 14935—Geo. A. Arnold	22 00	
No. 14936—S. Kaufman	10 00	
No. 16020—J. A. Richardson	81 85	
No. 16021—J. A. Richardson	52 70	
No. 16119—S. C. Wells	73 51	
No. 16297—J. P. Babcock	110 30	
No. 16375—A. Carlisle & Co.	12 50	
No. 16376—S. Kaufman	21 50	
Balance on hand June 30, 1891	753 74	
Totals	$5,000 00	$5,000 00

To balance brought down		$753 74
To balance from forty-first fiscal year		37 00
Warrant No. 286–Whittier, Fuller & Co.	$14 00	
No. 531—J. P. Babcock	106 40	
No. 532—S. C. Mills	59 60	
No. 659—F. M. Bacigalupi	251 69	
No. 660—Geo. H. Koppitz	359 05	
Totals	$790 74	$790 74

Expenditures during Forty-third Fiscal Year, ending June 30, 1892, Chargeable against the Appropriation for the Restoration and Preservation of Fish in the Waters of the State.

Appropriation April 6, 1891		$5,000 00
Warrant No. 2036—J. A. Richardson	$142 35	
No. 2037—S. C. Mills	63 50	
No. 2038—F. Bacigalupi	130 50	
No. 2039—J. W. Hartley	15 00	
No. 2040—J. P. Babcock	114 45	
No. 2041—R. E. Wilson	38 40	
No. 2071—J. P. Babcock	168 35	
No. 2472—Thos. Tunstead	251 70	
No. 2473—Benicia Agricultural Works	3 65	
No. 2474—S. C. Mills	60 00	
No. 4126—G. H. Koppitz	159 70	
No. 4127—F. Bacigalupi	133 25	
No. 4128—Thos. Tunstead	126 00	
No. 4362—S. C. Mills	60 15	
No. 4363—A. Haywood	25 00	
No. 4364—A. Haywood	25 00	
No. 4365—J. W. Hartley	15 00	
No. 4366—G. H. Koppitz	143 60	
No. 4441—Whittier, Fuller & Co.	29 25	
No. 4442—F. Bacigalupi	104 55	
No. 4443—G. H. Koppitz	104 65	
No. 4444—J. P. Babcock	113 65	
No. 5135—Thos. Tunstead	137 25	
No. 6016—J. P. Babcock	133 75	
No. 6017—S. C. Mills	69 10	
No. 6018—G. H. Koppitz	168 50	
No. 6019—Thos. Tunstead	136 50	
No. 6020—A. Haywood	25 00	
No. 6021—F. Bacigalupi	102 95	
No. 6061—J. W. Hartley	15 00	
No. 7715—S. C. Mills	62 40	
No. 7716—F. Bacigalupi	101 75	
No. 7717—Thos. Tunstead	142 45	
No. 7718—G. H. Koppitz	175 15	
No. 7719—J. P. Babcock	103 45	
No. 8156—J. W. Hartley	15 00	
No. 9170—F. Bacigalupi	102 25	
No. 9171—S. C. Mills	65 10	
No. 9172—G. H. Koppitz	123 40	
No. 9173—J. P. Babcock	100 95	
No. 9308—S. Kaufman	24 60	
No. 9309—A. Haywood	50 00	
No. 9310—J. W. Hartley	15 00	
No. 9556—Thomas Tunstead	110 00	
No. 10205—G. H. Koppitz	108 25	
No. 10206—Thomas Tunstead	139 70	
No. 10207—J. Batcheller	15 32	
No. 10208—S. C. Mills	59 15	
No. 10209—J. Nunan	15 00	
No. 10210—F. Bacigalupi	107 75	
No. 10211—J. P. Babcock	128 55	
No. 10615—J. W. Hartley	15 00	
No. 10616—A. Haywood	25 00	
No. 11325—S. C. Mills	76 25	
No. 11326—A. Haywood	25 00	
No. 11327—J. P. Babcock	115 90	
No. 11328—Thomas Tunstead	126 50	
No. 11398—F. Bacigalupi	11 25	
No. 14319—G. Jepson	41 13	
Totals	$5,000 00	$5,000 00

STATE HATCHERIES FUND.

Expenditures during the Forty-second Fiscal Year, ending June 30, 1891, Chargeable against the Appropriation for the Support and Maintenance of State Hatcheries.

Appropriation March 21, 1889		$5,000 00
Warrant No. 1631—J. G. Woodbury	$257 25	
No. 1632—J. M. Short	19 31	
No. 1633—E. M. Hunt	86 40	
No. 1634—J. A. Richardson	75 00	
No. 1635—J. Lowe	67 50	
No. 1636—B. Denton	9 00	
No. 1637—E. D. Stewart	53 25	
No. 1638—W. H. Schittyger	5 00	
No. 1639—P. M. McMahon	32 50	
No. 1640—W. H. Shebley	60 00	
No. 1812—J. Shebley, Jr.	50 00	
No. 1813—E. W. Hedson	13 00	
No. 1814—T. E. Sullivan	4 50	
No. 2586—Fireman's Insurance Co.	30 75	
No. 2587—E. W. Hunt	90 75	
No. 2588—W. H. Shebley	106 40	
No. 2589—J. G. Woodbury	188 77	
No. 2590—Holbrook, Merrill & Stetson	9 00	
No. 2591—J. Earle	16 50	
No. 2592—W. H. Schittyger	5 00	
No. 2593—J. Shebley, Jr.	50 00	
No. 2594—J. A. Richardson	82 65	
No. 2595—E. D. Stewart	50 00	
No. 2596—A. Russi	7 50	
No. 2597—G. M. Fulsom	39 64	
No. 2598—J. A. Richardson	75 00	
No. 3839—W. H. Shebley	112 80	
No. 3840—J. G. Woodbury	171 00	
No. 3841—J. H. Eigerman	25 00	
No. 3842—R. J. Waters	10 00	
No. 3843—J. A. Richardson	75 00	
No. 3844—J. A. Richardson	62 95	
No. 3845—E. W. Hunt	128 90	
No. 3846—J. Shebley, Jr.	47 70	
No. 3847—E. D. Stewart	50 00	
No. 5089—L. J. Griffin	38 14	
No. 5090—A. B. Morton	23 25	
No. 5091—E. W. Hunt	103 00	
No. 5092—W. H. Shebley	72 15	
No. 5093—J. G. Woodbury	149 80	
No. 5094—J. A. Richardson	75 00	
No. 5095—J. A. Richardson	32 10	
No. 5096—W. C. Tibbett	10 00	
No. 5097—Sisson, Crocker & Co.	88 57	
No. 5098—W. H. Hines	58 00	
No. 5099—E. D. Stewart	39 88	
No. 5100—J. H. Sisson	51 45	
No. 5968—J. Tonge	34 00	
No. 5969—E. Sullivan	18 00	
No. 5970—E. W. Hunt	78 55	
No. 5971—J. A. Richardson	75 00	
No. 5972—E. D. Stewart	18 45	
No. 5973—R. E. Wilson	55 00	
No. 5674—Leibenbaum Bros.	24 00	
No. 5975—A. Gallavan	7 38	
No. 5976—Fireman's Insurance Co.	31 80	
No. 5977—J. G. Woodbury	174 22	
No. 6062—G. Medson	44 00	
No. 6063—J. D. Harvey	1 35	
No. 10347—S. C. Wilson	8 00	
No. 10348—E. W. Hunt	80 25	
No. 10349—L. J. Griffen	23 23	
No. 10350—J. A. Richardson	10 50	
No. 10351—J. A. Richardson	75 00	
No. 10352—J. A. Richardson	4 75	
No. 10355—J. F. Moody	9 93	
No. 10375—Ward & Bailey	6 00	
No. 10747—J. G. Woodbury	134 85	
Amounts carried forward	$3,885 45	$5,000 00

Amounts brought forward	$3,885 45	$5,000 00
Warrant No. 13253—Lloyd Stone	12 50	
No. 13254—J. A. Richardson	75 00	
The above bills were passed by the previous Board, and paid out of the appropriation of the forty-second fiscal year by the present Board.		
No. 13255—Justinian Caire	1 68	
No. 13256—J. A. Richardson	8 25	
No. 13257—Sisson, Crocker & Co.	5 40	
No. 13258—E. W. Hunt	82 25	
No. 13259—L. C. Wilson	2 00	
No. 13260—L. J. Griffen	18 44	
No. 13704—J. G. Woodbury	132 25	
No. 14320—J. G. Woodbury	144 85	
No. 14388—J. A. Richardson	8 55	
No. 14389—J. A. Richardson	75 00	
No. 14390—L. L. Stone	30 00	
No. 14391—L. J. Griffen	23 98	
No. 14392—E. W. Hunt	91 00	
No. 14931—E. W. Hunt	54 60	
No. 14932—W. H. Schittyger	10 00	
No. 14933—Justinian Caire	3 99	
No. 15011—J. G. Woodbury	129 95	
No. 16018—J. A. Richardson	100 00	
Balance on hand June 30, 1891	104 86	
	$5,000 00	$5,000 00

To balance brought down		$104 86
Warrant No. 530—Ramon E. Wilson	$42 60	
No. 1168—J. A. Richardson	62 26	
	$104 86	$104 86

Expenditures during the Forty-third Fiscal Year, ending June 30, 1892, Chargeable against the Appropriation for the Support and Maintenance of State Hatcheries.

Appropriation April 6, 1891		$5,000 00
Warrant No. 2475—J. G. Woodbury	$50 00	
No. 4361—Stevens & McKenney	220 00	
No. 4440—Whittier, Fuller & Co.	22 62	
No. 3136—C. B. Guin & Co.	81 75	
No. 3137—J. A. Richardson	153 80	
No. 5138—E. W. Hunt	155 75	
No. 6022—L. Griffen	9 00	
No. 7448—J. A. Richardson	147 50	
No. 7449—E. W. Hunt	149 50	
No. 7450—Sisson, Crocker & Co.	9 33	
No. 8152—L. C. Neilson	51 00	
No. 8153—G. T. Mills	178 53	
No. 8154—E. W. Hunt	141 90	
No. 8135—L. Griffen	20 50	
No. 8321—J. A. Richardson	132 00	
No. 9553—L. Griffen	37 75	
No. 9554—E. W. Hunt	152 30	
No. 9555—J. A. Richardson	134 75	
No. 9864—J. Keboe	47 01	
No. 10217—E. W. Hunt	187 50	
No. 10218—G. T. Mills	13 00	
No. 10617—Whittier, Fuller & Co.	5 50	
No. 10618—W. W. Montague & Co.	7 05	
No. 10619—Huntington-Hopkins Co.	9 00	
No. 10620—Thos. Wood & Goldsack	5 00	
No. 10621—J. A. Richardson	144 00	
No. 10622—W. H. Shebley	126 25	
No. 11321—J. A. Richardson	149 15	
No. 11322—E. W Hunt	134 10	
No. 11323—W. H. Shebley	110 75	
No. 11441—L. A. Griffen	33 75	
No. 11442—W. H. Schittyger	35 00	
No. 11443—J. P. Chamber	20 00	
No. 11444—Angel Ditzzitgo	84 00	
No. 14153—J. M. Bowers, Jr.	15 22	
No. 14154—A. Howe	45 00	
No. 14137—T. E. Sullivan	58 00	
Amounts carried forward	$4,084 26	$5,000 00

Amounts brought forward	$4,084 26	$5,000 00
Warrant No. 14318—Lloyd Stone	10 00	
No. 14422—J. P. Chambers	5 00	
No. 14423—E. W. Hunt	146 50	
No. 14424—J. A. Richardson	144 90	
No. 14425—T. E. Sullivan	62 00	
No. 14426—C. B. Green	8 50	
No. 14427—L. Griffen	12 00	
No. 14428—G. H. Fuller	35 00	
No. 14429—A. Haywood	25 00	
No. 14430—J. W. Hartley	15 00	
No. 14431—W. H. Shebley	134 20	
No. 14432—S. Grandy	108 58	
No. 14734—S. C. Mills	61 20	
No. 15603—T. E. Sullivan	60 00	
No. 15604—W. Massop	22 65	
No. 15605—W. H. Shebley	120 40	
No. 15606—S. Nelson	33 00	
No. 15607—E. W. Hunt	141 82	
No. 15608—S. C. Mills	58 10	
No. 15609—J. W. Hartley	15 00	
No. 15610—L. Griffen	46 50	
No. 15611—J. A. Richardson	143 60	
No. 15612—S. Neilson	72 00	
No. 16040—J. P. Chambers	7 00	
No. 17953—J. W. Hartley	15 00	
No. 17954—S. C. Mills	64 40	
No. 17990—W. H. Shebley	127 95	
No. 17991—E. W. Hunt	148 30	
No. 18715—T. E. Sullivan	72 14	
Totals	$5,000 00	$5,000 00

FISH COMMISSIONERS' FUND.

Expenditures during the Forty-second Fiscal Year, ending June 30, 1891, Chargeable against the Fish Commissioners' Fund.

By balance on hand July 1, 1891		$47 26
Receipts into fund by old Board		1,723 03
Expenditures.		
Warrant No. 283—Wells, Fargo & Co.	$0 50	
No. 284—J. D. Harvey	5 00	
No. 441—M. J. O'Reilly	30 00	
No. 3439—E. W. Hunt	78 50	
No. 3440—H. Liddell	12 50	
No. 3441—E. D. Stewart	40 40	
No. 3442—E. D. Stewart	50 25	
No. 3443—H. D. Burton	70 00	
No. 3444—H. D. Burton	39 00	
No. 3445—Carson Lumber Co.	17 20	
No. 3446—T. W. O'Neill	70 00	
No. 3857—F. P. Callandun	123 50	
No. 5295—J. D. Harvey	5 00	
No. 5491—J. E. Todman	6 00	
No. 5497—J. E. Todman	20 00	
No. 5498—Jack Earle	67 50	
No. 5499—Justinian Caire	7 01	
No. 5500—Jack Earle	62 50	
No. 5501—J. D. Ennis	126 50	
No. 5502—Samuel Nicholls	65 00	
No. 5503—W. Schittyger	5 00	
No. 6709—J. F. Curley	228 05	
No. 6779—J. Shebley, Jr.	50 00	
No. 6780—W. H. Shebley	63 00	
No. 6781—W. H. Shebley	22 00	
No. 6782—E. W. Hunt	80 50	
No. 6783—J. Earle	21 00	
No. 6784—A. F. Caswell	27 50	
No. 6785—J. A. Richardson	100 30	
No. 6786—J. A. Richardson	95 05	
No. 6787—J. A. Richardson	135 00	
Balance on hand	46 53	
Totals	$1,770 29	$1,770 29

Expenditures during the Forty-third Fiscal Year, ending June 30, 1892, Chargeable against the Fish Commissioners' Fund.

By balance on hand July 1, 1892		$46 53
Receipts into fund, forty-third fiscal year		4,461 42
Expenditures.		
Warrant No. 2433—C. W. Neill	$189 00	
No. 2434—J. H. Sisson	47 15	
No. 2435—Sisson, Crocker & Co.	97 81	
No. 2436—J. G. Woodbury	150 25	
No. 2437—J. G. Woodbury	163 10	
No. 2450—J. G. Woodbury	213 95	
No. 4699—S. Kaufman	30 60	
No. 4700—J. W. Hartley	15 00	
No. 5134—Thos. Tunstead	137 60	
No. 7736—Thos. Tunstead	328 55	
No. 7737—Thos. Tunstead	57 08	
No. 7986—Thos. Tunstead	117 90	
No. 7987—J. A. Richardson	181 85	
No. 10282—Baker & Hamilton	21 60	
No. 10283—J. S. Lowe	221 28	
No. 10613—Hy. Hall & Co.	3 50	
No. 10614—Hy. Hall & Co.	381 00	
No. 11324—J. W. Hartley	15 00	
No. 15122—S. Kaufman	31 35	
No. 15123—F. P. Callandun	104 11	
No. 15124—L. Lagloria	102 00	
No. 15125—W. A. Schittyger	30 00	
No. 15126—J. D. Ennis	96 11	
No. 15127—G. Jepson	86 00	
No. 15263—T. W. O'Neill	196 00	
No. 15264—G. Jepson	112 00	
No. 15265—Thos. Tunstead	139 15	
No. 15266—J. P. Babcock	125 95	
No. 15628—J. P. Babcock	149 10	
No. 15629—A. Haywood	25 00	
No. 15630—Geo. H. Koppitz	141 75	
No. 16041—Thos. Tunstead	306 25	
No. 16407—S. Kaufman	52 70	
No. 18049—J. P. Babcock	141 91	
No. 18050—A. Haywood	25 00	
No. 18051.—F. M. Bacigalupi	97 71	
Balance on hand	163 64	
Totals	$4,507 95	$4,507 95
June 30, by balance on hand		$163 64

EXPENSES INCURRED

In the Construction of the Bear Valley Hatchery and Dam at Bear Valley, Marin County, State of California.

B. & J. S. Doe, building material	$221 28
S. Grandi, building material	9 73
S. Grandi, building material	101 58
A. Howe, building material	45 00
S. Grandi, building material	109 23
Andrew Howe, constructing building	100 00
Andrew Howe, carpenter work	281 00
Andrew Howe, setting water tanks and water gates	40 00
O. Hardman, labor	15 00
J. P. Chambers, cutting dam	20 00
Whittier, Fuller & Co., painting troughs	5 50
A. Pedrotti, hauling lumber for Bear Valley Hatchery	84 00
William Massop, freight on lumber	22 65
Total	$1,054 97

AMOUNT RECEIVED FROM LICENSES FOR THE YEAR ENDING MARCH 31, 1892.

Class.	Received of Controller.	Value of Each.	On Hand March 31, 1892.	Sold during the Year.	Total Value of Licenses Sold.	Commissions Paid for Collecting.	Net Amount Due the State.
A ----	500	$5 00	135	365	$1,825 00	$2 75	$1,821 25
B ----	50	7 50	20	30	225 00	1 10	223 90
C ----	50	10 00	43	7	70 00	--------------	70 00
D ----	50	12 50	16	34	425 00	--------------	425 00
E ----	50	----------	49	1	25 00	--------------	25 00
Totals	700	----------	263	437	$2,570 00	$4 85	$2,565 15

AMOUNT RECEIVED FROM LICENSES FROM APRIL 1, 1892, TO SEPTEMBER 1, 1892.

Class.	Received of Controller.	Value of Each.	On Hand September 1, 1892.	Sold during the Year.	Total Value of Licenses Sold.	Net Amount Due the State.
A --------------	500	$5 00	125	375	$1,875 00	$1,875 00
B --------------	50	7 50	24	26	195 00	195 00
C --------------	50	10 00	44	6	60 00	60 00
D --------------	50	12 50	19	31	387 50	387 50
E --------------	50	------------	49	1	25 00	25 00
Totals --------	700	------------	261	439	$2,542 50	$2,542 50

BULLETINS ISSUED BY THE FISH COMMISSION.

Office of the Board of Fish Commissioners,
San Francisco, October 12, 1891.

[Bulletin No. 1.]

A question having been made as to the classification of certain fish found in Eel River, in salt water, during the month of September, specimens were obtained ranging from one third of a pound to a pound, and sent by the Commission to Dr. David S. Jordan, the well-known ichthyologist, now President of the Leland Stanford, Junior, University, for classification. He pronounces them trout—young Steel-heads (*Salmo gairdneri*, Richardson).

Under the law, Section 632 of the Penal Code of the State of California, it is unlawful to catch these fish at any time, except with hook and line.

Issued by order of the Board.

RAMON E. WILSON,
Secretary.

Office of the Board of Fish Commissioners,
San Francisco, October 12, 1891.

[Bulletin No. 2.]

Dr. David S. Jordan, now President of the Leland Stanford, Junior, University, and Dr. Charles H. Gilbert, Professor of Vertebrate Zoölogy in the same University, both well-known ichthyologists, have very kindly offered to assist the Commission in classifying any fish which may be sent to them.

Specimens of trout taken from Lake Webber have recently been sent to Dr. Jordan, which, he says, belong to the form known as the Tahoe trout (*Salmo henshawi*). He now regards these trout as a variety of the Red-throated trout, and writes its name as *Salmo mykiss henshawi*.

He has substituted the word *mykiss* for *purpuratus*, as it is a much older name than the latter.

The trout found in Webber Lake are said to have been planted many years ago by Dr. Webber, and that he took the original stock from Feather River. They have been commonly known in California as the Feather River, or Cut-throat trout.

Issued by order of the Board.

RAMON E. WILSON,
Secretary.

Office of the Board of Fish Commissioners,
San Francisco, October 24, 1891.

[Bulletin No. 3.]

In the early part of the month of October, Capt. A. W. Foster, of Sacramento, sent to the Commission specimens of trout caught by him in Klamath River, at Beswick. The specimens thus obtained were sent to Dr. David S. Jordan for classification. He classifies the fish as Steelhead trout (*Salmo gairdneri*), and says: "They correspond more nearly to the Salmon trout of England than do any other of our American species. The name Salmon trout is promiscuously used for all sorts of large trout or small salmon, but if any fish on this west coast is entitled to that name it is the Steel-head."

Issued by order of the Board.

RAMON E. WILSON,
Secretary.

Office of the Board of Fish Commissioners,
San Francisco, February 15, 1892.

[Bulletin No. 4.]

By permission of Dr. David Starr Jordan, President of the Leland Stanford, Junior, University, the Board of Fish Commissioners of the State of California take pleasure in presenting the following able and instructive discourse on the subject of "Salmon and Trout of the Pacific Coast."

Issued by order of the Board.

RAMON E. WILSON,
Secretary.

SALMON AND TROUT OF THE PACIFIC COAST.

By Dr. David Starr Jordan, President Leland Stanford, Junior, University.

Of all the families of fishes, the one most interesting from almost every point of view is that of the *Salmonidæ*, the Salmon family. As now understood, it is not one of the largest families, as it comprises less than a hundred species; but in beauty, activity, gaminess, quality as food, and even in size of individuals, different members of the group stand easily with the first among fishes.

The *Salmonidæ* are found only in the North Temperate and Arctic regions, and within this range they are everywhere almost equally abundant wherever suitable waters occur. Some of the species, especially the larger ones, are marine and anadromous, living and growing in the sea, and ascending fresh waters to spawn. Still others live in running brooks, entering lakes or the sea when occasion serves, but not habitually doing so. Still others are lake fishes, approaching the shore or entering brooks in the spawning season; at other times retiring to waters of considerable depth. Some of them are active, voracious, and gamy, while others are comparatively defenseless and will not take the hook.

All the *Salmonidæ* feed upon fish; the smaller ones upon worms, insects, and small fish; the larger forms on fishes and crustacea—whatever they can find. The eggs of the species are much larger than in fishes generally, and the ovaries are without special duct, the eggs falling into the cavity of the abdomen before they are excluded. The large size of the eggs, the fact that they do not stick together, and the ease with which they may be impregnated, render all the *Salmonidæ* peculiarly adapted for artificial culture.

Naturalists divide the *Salmonidæ* into nine genera: *Coregonus*, the White Fish; *Plecoglossus*, a little annual fish which is found in the waters of Japan, born in the spring, runs up the rivers in the summer, and dies the following winter, only the young surviving; *Brachymystax*, a large and scarcely known salmon-like fish in the waters of Siberia; *Stenodus*, the Inconnu, a large, weak-tooth salmon found in the Mackenzie River; *Thymallus*, the Grayling; *Hucho*, the Huchen, or Rothfisch of the River Danube, a large, voracious, pike-like salmon, which seems to be little known either to naturalists or to anglers; *Oncorhynchus*, the Pacific Coast salmon, or Quinnats; *Salmo*, the salmon and trout; and *Salvelinus*, the Charr, or Red-spotted trout.

Of these, the various fishes commonly known as salmon and trout belong to the last three genera. The others need not be further mentioned in the present discussion. In order to get a better idea of the proper application of the various vernacular names that are used in America, it is necessary to go back to Europe, the source from which these names have been drawn. First, we have a large fish, common in the salt waters of northern Europe, spending most of its life near the shores in regions where the water is cold and clear, and ascending the rivers in the spring when the high water comes down from the mountains, going through rapids with great force, leaping cataracts, and finally casting its spawn on the gravelly bed of a small stream. This was known to the Latin writers as *Salmo*, the word coming from *salio*, which means "to leap," and in the different languages which are derived from the Latin having as its names some form of the word "salmon." The scientific name of this fish is *Salmo salar*.

Very similar to the salmon in all technical respects, like it having black spots over the surface of the body and rather large silvery scales, is a smaller fish which rarely descends to the sea, and makes its home in the rivers and lakes throughout northern and central Europe. This fish was known by the name of *Fario* to the old Latin writers, the most important of whom, in this regard, was Ansonius, who wrote feelingly and poetically of the fishes of the River Moselle. From the Latin word "fario" comes the German name "forelle." This fish is the trout of all English writers, the trout of Izaak Walton, and its scientific name is *Salmo fario*.

Half way between the salmon and the trout there is a large trout which lives mostly in the estuaries of the rivers, sometimes mistaken for salmon, sometimes for trout, rarely ascending the rivers very far, and seldom venturing far into the sea. This is the Trutta of the Latin authors, from which the word "trout" originally comes, although, as it has happened, the word "fario" has become, in its various forms, the name of the trout in all the German* and Scandinavian countries, while derivatives of the word "trutta" have come to mean the same fish in the Latin† countries and with the English. The scientific name of this large fish, half salmon and half trout in appearance, altogether trout in fact, is *Salmo trutta*, and to this fish properly belongs the name of Salmon trout.

There are thus in England, whence our names have come, three species of black-spotted silvery fishes of this family: (1) The Salmon, largest of all and anadromous, that is, running up the rivers to spawn, and living in the sea; (2) the Trout, living in the brooks and the lakes only; (3) the Salmon trout, which stands between the two. All three belong to the genus *Salmo*, and the only difference of any importance between the salmon and the trout, so far as structure goes, lies in the fact that the salmon shed the teeth on its vomer, that is, the middle part of the roof of its mouth, as it grows older, while in the trout these teeth are preserved throughout the life of the animal. Living in salt water, and feeding on large fishes and crustacea, the salmon is the more vigorous, with coarser and more oily flesh, but this difference becomes of small importance as a matter of distinguishing species.

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* German, Forelle; Danish, Forelse, etc.

† French, Truite; Spanish, Trucha; English, Trout, etc.

Besides these three, there is another and a finer fish, found in the coldest and clearest lakes of the Alps and of northern Europe, dark colored and spotted with bright red, the scales so small that they seem as mere impressions in the slimy skin, so that the average fisherman does not recognize their existence. This is a finer and more beautiful fish than any of the trout, and it is very much less abundant. This is known in England as the Charr, and on the Continent it has, in Germany, the name of Saibling or Sälbling (both words from the low Latin name *Salvelinus*, which again is a sort of diminutive of *Salmo*—a little salmon); in France it is called the Ombre Chevalier, which in turn comes from the Latin name *Umbla*, given to the same fish in allusion to its dark colors, and its love of shady places in the lakes and brooks. This charr differs from all the trout in various anatomical respects, the most notable of which is the entirely different form of its vomer, a form which could only be satisfactorily described by a series of comparative drawings. This character of the vomer distinguishes the genus *Salvelinus*, to which the Saibling belongs, its scientific name being *Salvelinus alpinus*.

Armed with these names of Salmon, Trout, Salmon trout, and Charr, our ancestors came to America. The name "charr" was doubtless unfamiliar to most of them, for the charr is scarcely found in England except in the lake district of Cumberland, and for this reason, I suppose, it has never been in common language applied to any American fish.

Our ancestors found running up the rivers of the Atlantic Coast, a large fish precisely like the salmon of Europe; in fact, the very same thing, and so they naturally and correctly enough called it Salmon. In the fresh waters of New England and New York, in all the clear streams throughout the Alleghany region, and in the lakes of Canada and to the northwest, our forefathers found a red-spotted, fine-scaled, dark-colored speckled beauty. Finding no real trout with black spots and large scales in the rivers, and having forgotten the name of "charr," they gave to this fish the name of trout, or Speckled trout, or Brook trout, and in spite of the fact that in reality it is not a trout, but a charr, the name Brook trout is likely to adhere forever to the *Salvelinus fontinalis*.

Real trout there are none on our Atlantic Coast, and Salmon trout is likewise wanting, but the name Salmon trout is often given to the Brook trout, or charr, which has run out into the sea; and it is also often given to another charr, a very large, coarse species, in which the red spots have faded out to a cream color, which is found in all the lakes from Alaska to Maine, across the northern half of our continent. This is the Great Lake trout (*Salvelinus namaycush*), and except for its large size and comparative coarseness, it would never be mistaken either for trout or salmon. The name Salmon trout is wholly inapplicable to it.

In the lakes of Greenland and the eastern part of British America, the European charr (*Salvelinus alpinus*) is as abundant as it is in Europe—a fact which has been only lately made manifest, and even yet there is some question whether some of these which are found in the lakes in New Hampshire have not some time or other been brought over and planted there from Europe.

In the lakes of Maine, and on the north, there is still another charr, smaller and finer than the European one, the Blue-back trout of the Rangley Lakes, known as *Salvelinus oquassa*.

Thus, instead of one of the salmon, salmon trout, trout, and charr, of Europe, we have in the Eastern States the same salmon, the same charr, and three other charrs, but neither the trout nor the salmon trout.

In coming to the Pacific Coast, the settlers of California brought the names with them from the East, but found none of the fishes to which they had been accustomed. Salmon they found, similar in habits and in value as food, but many of them larger, finer, and vastly more abundant than any of the salmon of Europe. California salmon differ from all the rest of the salmon family in the fact that the number of rays in the anal fin is from fourteen to twenty, while in all the salmon and trout on the other side of the Atlantic this fin contains no more than nine or ten rays. The Pacific Coast salmon have also an increased number of branchiostegals, an increased number of gill-rakers, and a much larger number of pyloric cœca, or glands, about the stomach. They are, therefore, in strictness, not salmon at all, but something more intensely salmon than the salmon of Europe itself really is. They have therefore been placed in another genus known as *Oncorhynchus*. For the lack of any other common name they are always spoken of and will always be canned, as long as the canning industry lasts, under the name of Salmon. The Chinook name, *Quinnat*, was early applied to them, and if we feel the need of some other name to distinguish them from real salmon we may call the Pacific Coast salmon Quinnat, or Quinnat Salmon. These species all live in the ocean, ascend the rivers in the spring and summer, spawn in fresh water in the fall, the young, as soon as they are able to swim, floating tail foremost down the river and growing rapidly as soon as they reach the ocean and the peculiar ocean food. There are five species of these Quinnats, which will be described farther on.

Besides the salmon, the settlers of California found in the brooks an abundance of what they called trout. These are black-spotted, silver-scaled, and in every way closely resemble the trout of Europe, and are wholly unlike the charr, or so-called trout of the Eastern States. The name trout by rights belongs to these fishes, and they are placed in the genus *Salmo*. The three species of trout found in the Pacific waters will be mentioned farther on. One of these is so similar to the Salmon trout of Europe that it might fairly be called, as it often is called, by the same name.

A charr is also found in Pacific waters, but as the name "charr" had been wholly forgotten by our ancestors, they could only call this, like the others, a trout. In Oregon the red-spotted trout, or charr, is distinguished by the name of Bull trout. In California it had, for a long time, no distinctive name. A landlady in some hotel in the neighborhood of the United States Fish Hatchery at Baird, on the McCloud

River, at the time of the Dolly Varden craze, noticing the gaudy colors of this California charr, proposed to call it the Dolly Varden trout. This name coming to the ears of Professor Baird, then United States Fish Commissioner, pleased his fancy. and he directed me, who then had the classification of the trout in the Smithsonian Institution in hand, to continue for this species the common name of Dolly Varden trout, and so, in the books at least, Dolly Varden trout it is to this day.

Turning back to the Quinnat salmon, or the salmon of the Pacific Coast, we often find persons puzzled to distinguish its young from the various forms of trout. Any person who can count, and will take the trouble to learn which of the fins is the anal fin—the one on the lower side just behind the vent—can distinguish the young Quinnat salmon from any form of trout. All the so-called salmon of the Pacific Coast, all the species of *Oncorhynchus*, have an increased number of rays in the anal fin, from fourteen to twenty, while all forms of trout in whatever country, all the charrs and the Atlantic Coast salmon, have in this fin but nine or ten rays. This is a matter of some importance, in view of the fact that the fishery laws of this State discriminate between trout and salmon, permitting the catching of the one, when to take the other is forbidden.

The existence of large salmon-like fishes in the Pacific has long been known. The different species were recognized about one hundred and forty years ago by that most exact of early observers, Steller, who described and distinguished them with perfect accuracy, under their Russian vernacular names. These Russian names were, in 1792, adopted by Walbaum as specific names, in giving to these animals scientific names. Since Steller's time, writers of all degrees of incompetence, and writers with scanty material or with no material at all, have done their worst to confuse our knowledge of these salmon, until it became evident that no exact knowledge of any of the species remained. In the current system of a few years ago,* the breeding males of the five species known to Steller constituted a separate genus of many species (*Oncorhynchus*, Suckley); the females were placed in the genus *Salmo*, and the young formed still another species of a third genus, called *Fario*, supposed to be a genus of trout. The young breeding males (*grilse*) of one of the species (*Oncorhynchus nerka*) made still a fourth genus, designated as *Hypsifario*. Not one of the writers on these fishes of thirty years ago knew a single species definitely, at sight, or used knowingly in their descriptions a single character by which species are really distinguished. Not less than thirty-five nominal species of *Oncorhynchus* have already been described from the North Pacific, although, so far as is now known, only the five originally noticed by Steller really exist. The descriptive literature of the Pacific salmon is among the very worst extant in science. This is not, however, altogether the fault of the authors, but it is in great part due to the extraordinary variability in appearance of the different species of salmon. These variations are, as will be seen, due to several different causes, notably to differences in surroundings, in sex, and in age, and in conditions connected with the process of reproduction. The writer and his associate, Prof. Charles H. Gilbert, have had, under the auspices of the United States Fish Commission, better opportunities to study the different species of *Oncorhynchus* than had fallen to the lot of any previous ichthyologists. Entirely similar conclusions have been independently reached by Dr. Tarleton H. Bean, of the United States Fish Commission, who had several times visited Alaska for the purpose of investigating its salmon fisheries, and whose means of studying the different species has been as extensive as ours. It is very gratifying to see that the results of these different sets of observations agree in all essential respects, and also agree fully with the observations made so long ago by Steller.

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* See report U. S. Pacific R. R. Explorations, 1858.

All of these authorities recognize the existence of five species of *Oncorhynchus* inhabiting both shores of the North Pacific. There is no evidence of the existence of any more on either the American or the Asiatic side. These species may be called: (1) The Quinnat, or King salmon; (2) the Blue-back salmon, or Red-fish; (3) the Silver salmon; (4) the Dog salmon, and (5) the Humpback salmon; or (1) *Oncorhynchus tschawytscha;* (2) *Oncorhynchus nerka;* (3) *Oncorhynchus kisutch;* (4) *Oncorhynchus keta*, and (5) *Oncorhynchus gorbuscha.* All these species are now known to occur in the waters of Kamtschatka as well as in those of Alaska and Oregon. These species, in all their varied conditions, may usually be distinguished by the characters given below. Other differences of form, color, and appearance are absolutely valueless for distinction, unless specimens of the same age, sex, and condition are compared.

The King salmon, or true Quinnat, or Chinook salmon (*Oncorhynchus tschawytscha*), has an average weight of 22 pounds, but individuals weighing 70 to 100 pounds are occasionally taken. It has about 16 anal rays, 15 to 19 branchiostegals, 23 (9+14) gill-rakers on the anterior gill arch, and 140 to 185 pyloric cœca. The scales are comparatively large, there being from 130 to 155 in a longitudinal series. In the spring the body is silvery, the back dorsal fin and caudal fin having more or less of round black spots, and the sides of the head having a peculiar tin-colored metallic luster. In the fall the color is often black or dirty red, and the species can then only be distinguished from the Dog salmon by its technical characters.

The Blue-back salmon (*Oncorhynchus nerka*) usually weighs from 5 to 8 pounds. It has about 14 developed anal rays, 14 branchiostegals, and 75 to 95 pyloric cœca. The gill-rakers are more numerous than in any other salmon, the number being usually about 39 (16+23). The scales are larger, there being 130 to 140 in the lateral line. In the spring the form is plumply rounded, and the color is a clear, bright blue above, silvery below, and everywhere immaculate. Young fishes often show a few round black spots, which disappear when they enter the sea. Fall specimens in the lakes are bright red in color, hook-nosed, and slab-sided, and bear little resemblance to the spring run. Young spawning male grilse are also peculiar in appearance, and were for a time considered as forming a distinct genus, under the name of "*Hypsifario kennerlyi.*" This species appears to be sometimes land-locked in mountain lakes, in which case it reaches but a small size. Such specimens, called "Kokos" by the Indians, have been sent us from Lake Whatcom, Washington, by Mr. T. J. Smith, of Whatcom. Similar specimens have been sent in from other mountain lakes.

The Silver salmon (*Oncorhynchus kisutch*) reaches a weight of 3 to 8 pounds. It has developed rays in the anal, 13 branchiostegals, 23 (10+13) gill-rakers, and 45 to 80 pyloric cœca. There are about 127 scales in the lateral line. In color it is silvery in spring, greenish above, and with a few faint black spots on the upper parts only. In the fall the males are mostly of a dirty red.

The Dog salmon (*Oncorhynchus keta*) reaches an average weight of about 12 pounds. It has about 14 anal rays, 14 branchiostegals, 24 (9+15) gill-rakers, and 140 to 185 pyloric cœca. There are about 150 scales in the lateral line. In spring it is dirty silvery, immaculate, or sprinkled with small black specks, the fins dusky. In the fall the male is brick-red or blackish, and its jaws are greatly distorted.

The Humpback salmon (*Oncorhynchus gorbuscha*) is the smallest of the species, weighing from 3 to 6 pounds. It has usually 15 anal rays, 12 branchiostegals, 28 (13+15) gill-rakers, and about 180 pyloric cœca. Its scales are much smaller than in any other salmon, there being 180 to 240 in the lateral line. In color it is bluish above, silvery below, the posterior and upper parts with many round black spots. The males in the fall are red, and are more extravagantly distorted than in any other in the *Salmonidæ*.

Of these species the Blue-back predominates in Fraser River and in the Yukon River, the Silver salmon in Puget Sound, the Quinnat in the Columbia and the Sacramento, and the Silver salmon in most of the streams along the coast. All the species have been seen by us in the Columbia and in Fraser River; all but the Blue-back in the Sacramento and in waters tributary to Puget Sound. Only the King salmon has been noticed south of San Francisco. Its range has been traced as far as Ventura River. Of these species, the King salmon and Blue-back salmon habitually "run" in the spring, the others in the fall. The usual order of running in the rivers is as follows: *nerka*, *tschawytscha*, *kisutch*, *gorbuscha*, *keta*.

The economic value of the spring-running salmon is far greater than that of the other species, because they can be captured in numbers when at their best, while the others are usually taken only after deterioration. To this fact the worthlessness of *Oncorhynchus keta*, as compared with the other species, is probably wholly due.

The habits of the salmon in the ocean are not easily studied. King salmon and Silver salmon of all sizes are taken with the seine at almost any season in Puget Sound. This would indicate that these species do not go far from the shore. The King salmon takes the hook freely in Monterey Bay, both near the shore and at a distance of six to eight miles out. We have reason to believe that these two species do not necessarily seek great depths, but probably remain not very far from the mouth of the rivers in which they were spawned. The Blue-back and the Dog salmon probably seek deeper water, as the former is seldom or never taken with the seine in the ocean, and the latter is known to enter the Strait of Fuca at the spawning season, therefore coming in from the open sea. The great majority of the King salmon, and nearly all the Blue-back salmon, enter the rivers in the spring. The run of both begins generally at the last of March; it lasts, with various modifications and interruptions, until the actual spawning season in November, the time of running and the proportionate amount in each of the subordinate runs varying with each different river. In general, the runs are slack in the summer and increase with the first high water of autumn. By the last of August only straggling Blue-backs can be found in the lower course of any stream; but both in the Columbia and in the Sacramento the Quinnat runs in considerable numbers, at least till

October. In the Sacramento the run is greatest in the fall, and more run in the summer than in spring. In the Sacramento and the smaller rivers southward, there is a winter run, beginning in December. The spring salmon ascends only those rivers which are fed by the melting snows from the mountains, and which have sufficient volume to send their waters well out to sea. Those salmon which run in the spring are chiefly adults (supposed to be at least three years old). Their milt and spawn are no more developed than at the same time in others of the same species which are not to enter the rivers until fall. It would appear that the contact with cold fresh water, when in the ocean, in some way causes them to run towards it, and to run before there is any special influence to that end exerted by the development of the organs of generation. High water on any of these rivers in the spring is always followed by an increased run of salmon. The salmon canners think, and this is probably true, that salmon which would not have run till later are brought up by the contact with the cold water. The cause of this effect of cold fresh water is not understood. We may call it an instinct of the salmon, which is another way of expressing our ignorance. In general, it seems to be true that in those rivers and during those years when the spring run is greatest, the fall run is least to be depended upon.

As the season advances, smaller and younger salmon of these species (Quinnat and Blue-back) enter the rivers to spawn, and in the fall these young specimens are very numerous. We have thus far failed to notice any gradations in size or appearance of these young fish by which their ages could be ascertained. It is, however, probable that some of both sexes reproduce at the age of one year. In Fraser River, in the fall, Quinnat male grilse of every size, from 8 inches upwards, were running, the milt fully developed, but usually not showing the hooked jaws and dark colors of the older males. Females less than 18 inches in length were rare. All of either sex, large and small, then in the river, had the ovaries or milt developed. Little Blue-backs of every size, down to 6 inches, are also found in the upper Columbia in the fall, with their organs of generation fully developed. Nineteen twentieths of these young fish are males, and some of them have the hooked jaws and red color of the old males.

The average weight of the Quinnat in the Columbia in the spring is 22 pounds; in the Sacramento, about 16. Individuals weighing from 40 to 60 pounds are frequently found in both rivers, and some as high as 80 or even 100 pounds are recorded. It is questioned whether these large fishes are those which, of the same age, have grown more rapidly; those which are older, but have for some reason failed to spawn, or those which have survived one or more spawning seasons. All these origins may be possible in individual cases; we are, however, of the opinion that the majority of these large fishes are those which have hitherto run in the fall, and thus having spawned not far from the sea, have survived the spawning season of the previous year.

Those fish which enter the rivers in the spring continue their ascent till death or the spawning season overtakes them. Probably none of them ever return to the ocean, and a large proportion fail to spawn. They are known to ascend the Sacramento to its extreme headwaters, about four hundred miles. In the Columbia they ascend as far as the Bitter Root Mountains, and at least to the Spokane Falls, and their extreme limit is not known. This is a distance of six to eight hundred miles. At these great distances, when the fish have reached the spawning grounds, besides the usual changes of the breeding season, their bodies are covered with bruises, on which patches of white fungus develop. The fins become mutilated, their eyes are often injured or destroyed, parasitic worms gather in their gills, they become extremely emaciated, their flesh becomes white from the loss of oil, and as soon as the spawning act is accomplished, and sometimes before, *all* of them die. The ascent of the Cascades and the Dalles probably causes the injury or death of a great many salmon.

When the salmon enter the river they refuse to take bait, and their stomachs are always found empty and contracted. In the rivers they do not feed, and when they reach the spawning grounds their stomachs, pyloric cœca and all, are said to be no larger than one's finger. They will sometimes take the fly, or a hook baited with salmon roe, in the clear waters of the upper tributaries, but there is no evidence known to us that they feed when there. Only the Quinnat and Blue-back (there called Red-fish) have been found at any great distance from the sea, and these (as adult fishes) only in late summer and fall.

The spawning season is probably about the same for all the species. It varies for each of the different rivers, and for different parts of the same river. It doubtless extends from July to December. The manner of spawning is probably similar for all the species, but we have no data for any except the Quinnat. In this species the fishes pair off; the male, with tail and snout, excavates a broad, shallow "nest" in the gravelly bed of the stream, in rapid water, at a depth of one to four feet; the female deposits her eggs in it, and, after the exclusion of the milt, they cover them with stones and gravel. They then float down the stream tail foremost. As already stated, a great majority of them die. In the headwaters of the large streams, unquestionably all die; in the small streams, and near the sea, an unknown percentage probably survive. The young hatch in about sixty days, and most of them return to the ocean during the high water of the spring.

The salmon of all kinds, in the spring, are silvery, spotted or not, according to the species, and with the mouth about equally symmetrical in both sexes. As the spawning season approaches, the female loses her silvery color, becomes more slimy, the scales on the back partly sink into the skin, and the flesh changes from salmon-red and becomes variously paler from the loss of oil, the degree of paleness varying much with individuals and with inhabitants of different rivers. In the Sacramento the flesh of the Quinnat, in either spring or fall, is rarely pale. In the Columbia a few with pale flesh are sometimes taken in the spring, and a good many in the fall. In Fraser River the fall run of the Quinnat is nearly worthless for canning purposes, because so many are "white-meated." In the spring very few are "white-meated," but the number increases towards fall, when there is every variation, some having red streaks running through them, others being red toward the head and pale toward the tail. The red and pale ones cannot be distinguished externally, and the color is dependent on neither age nor sex. There is said to be no difference in the taste, but there is no market for canned salmon not of the conventional orange color.

As the season advances, the difference between the males and females becomes more and more marked, and keeps pace with the development of the milt, as is shown by dissection. The males have (1) the premaxillaries and the tip of the lower jaw more and more prolonged, both of the jaws becoming, finally, strongly and often extravagantly hooked, so that either they shut by the side of each other like shears, or else the mouth cannot be closed. (2) The front teeth become very long and canine-like, the growth proceeding very rapidly, until they are often half an inch long. (3) The teeth on the vomer and tongue often disappear. (4) The body grows more compressed and deeper at the shoulders, so that a very distinct hump is formed; this is more developed in *Oncorhynchus gorbuscha*, but is found in all. (5) The scales disappear, especially on the back, by the growth of spongy skin. (6) The color changes from silvery to various shades of black and red, or blotchy, according to the species. The Blue-back turns rosy red, the Dog salmon a dull, blotchy red, and the Quinnat generally blackish. The distorted males are commonly considered worthless, rejected by the canners and salmon salters, but preserved by the Indians. These changes are due solely to influences connected with the growth of the reproductive organs. They are not in any way due to the action of fresh water. They take place at about the same time in the adult males of all species, whether in the ocean or in the rivers. At the time of the spring runs all are symmetrical. In the fall all males, of whatever species, are more or less distorted. Among the Dog salmon, which run only in the fall, the males are hook-jawed and red-blotched when they first enter the Strait of Fuca from the outside. The Humpback, taken in salt water about Seattle, have the same peculiarities. The male is slab-sided, hook-billed, and distorted, and is rejected by the canners. No hook-jawed females of any species have been seen. It is not positively known that any fully hook-jawed old male survives the reproductive act. If any do, the jaws must resume the normal form.

On first entering a stream the salmon swim about as if playing. They always head towards the current, and this appearance of playing may be simply due to facing the moving tide. Afterwards they enter the deepest parts of the stream and swim straight up, with few interruptions. Their rate of travel at Sacramento is estimated by Stone at about two miles per day; on the Columbia at about three miles per day. Those who enter the Columbia in the spring and ascend to the mountain rivers of Idaho, must go at a more rapid rate than this, as they must make an average of nearly four miles per day.

As already stated, the economic value of any species depends in great part on its being a "spring salmon." It is not generally possible to capture salmon of any species in large numbers until they have entered the rivers, and the spring salmon enters the rivers long before the growth of the organs of reproduction has reduced the richness of the flesh. The fall salmon cannot be taken in quantity until their flesh has deteriorated; hence, the Dog salmon is practically almost worthless, except to the Indians, and the Humpback salmon is little better. The Silver salmon, with the same breeding habits as the Dog salmon, is more valuable, as it is found in the inland waters of Puget Sound for a considerable time before the fall rains cause the fall runs, and it may be taken in large numbers with seines before the season for entering the rivers. The Quinnat salmon, from its great size and abundance, is more valuable than all the other fishes on our Pacific Coast taken together. The Blue-back, similar in flesh, but much smaller and less abundant, is worth much more than the combined value of the three remaining species of salmon.

The fall salmon of all species, but especially of the Dog salmon, ascend streams but a short distance before spawning. They seem to be in great anxiety to find fresh water, and many of them work their way up little brooks only a few inches deep, where they perish miserably, floundering about on the stones. Every stream, of whatever kind, has more or less of these fall salmon.

It is the prevailing impression that the salmon have some special instinct which leads them to return to spawn in the same spawning grounds where they were originally hatched. We fail to find any evidence of this in the case of the Pacific Coast salmon, and we do not believe it to be true. It seems more probable that the young salmon hatched in any river mostly remain in the ocean, within a radius of twenty, thirty, or forty miles of its mouth. These, in their movements about in the ocean, may come into contact with the cold waters of their parent rivers, or, perhaps, of any other river, at a considerable distance from the shore. In the case of the Quinnat and the Blue-back, their "instinct" seems to lead them to ascend these fresh waters, and, in a majority of cases, these waters will be those in which the fishes in question were originally spawned. Later in the season the growth of the reproductive organs leads them to approach the shore and search for fresh waters, and still the chances are that they may find the original stream. But undoubtedly many fall salmon ascend, or try to ascend, streams in which no salmon were ever hatched. In little brooks about Puget Sound, where the water is not three inches deep, are often found dead or dying salmon, which have entered them for the purpose of spawning. It is said of the Russian River and other California rivers, that their mouths, in the time of low water in summer, generally become entirely closed by sand-bars, and that the salmon, in their eagerness to ascend them, frequently fling themselves entirely out of water on the beach. But this does not prove that the salmon are guided by a marvelous geographical instinct, which leads them to their parent river in spite of the fact that the river cannot be found. The waters of Russian River soak through these sand-bars, and the salmon instinct, we think, leads them merely to search for fresh waters. This matter is much in need of further investigation; at present, however, we find no reason to believe that the salmon enter the Rogue River simply because they were spawned there, or that a salmon hatched in the Clackamas River is more likely, on that account, to return to the Clackamas than to go up the Cowlitz or the Des Chûtes. "At the hatchery on Rogue River the fish are stripped, marked, and set free, and every year since the hatchery has been in operation some of the marked fish have been recaught. The young fry are also marked, but none of them have been recaught."

In regard to the diminution of the number of salmon on the coast, Dr. Gilbert and myself published in 1880, in the report of the United States Census Bureau, the following observations: "In Puget Sound, Fraser River, and the small streams, there appears to be little or no evidence of diminution. In the Columbia River the evidence appears somewhat conflicting. The catch in 1880 was considerably greater than ever before (nearly five hundred and forty thousand cases of forty-eight pounds each having been packed), although the fishing for three or four years has been extensive. On the other hand, the high water of that year undoubtedly caused many fish to become spring salmon which would otherwise have run in the fall. Moreover, it is urged that a few years ago, when the number caught was about half as great as in 1880, the amount of netting used was perhaps one eighth as much. With a comparatively small outfit the canners caught half the fish; now, with nets much larger and more numerous, they catch them nearly all, scarcely any escaping during the fishing season (April 1st to August 1st). Whether an actual reduction in the number of fish running can be proved or not, there can be no question that the present rate of destruction of the salmon will deplete the river before many years. A considerable number of Quinnat salmon run in August and September, and some stragglers even later; these are all which now keep up the supply of fish in the river. The non-molestation of this fall run, therefore, does something to atone for the almost total destruction of the spring run. This, however, is insufficient. A well-ordered salmon hatchery is the only means by which the destruction of the salmon fisheries of the Columbia can be prevented."

Since this was written the over-fishing has gone on steadily, the number of nets used is two or three times as great as it was in 1880, while the catch has steadily fallen off. Seines are now used freely in the Columbia, and other appliances by which great numbers of young salmon, too small for use in the canneries, are destroyed, and the utter disappearance of the salmon fishery of the Columbia is only a question of a few years unless some vigorous means is taken to prevent over-fishing, to prevent the destruction of young fish, and to replenish the losses from all these causes. The same story of the destruction of the rich fisheries of the Columbia will be told again in the Fraser River and in the Yukon, and in every other stream where unlimited fishing is allowed, and where no adequate effort is made to keep up the supply. Just as the forests are wantonly and thoughtlessly destroyed by early settlers and by lumbermen, just so the fisheries of this coast will go under the hands of the canner.

Of the American trout, the one which most nearly approaches the European *Salmo fario*, is the Rainbow trout of California, *Salmo irideus*, as it was named some forty years ago by Dr. W. P. Gibbons, of Alameda. The name Rainbow trout is simply a translation of the Latin name *irideus* given by Dr. Gibbons, and in default of any better common name this name is likely to last. The distinctive characters of this trout lie mainly in the large scales (about 135) in a lengthwise series, in the comparatively small mouth and plump body. The color is bluish, the sides silvery, usually with a red lateral band, and marked with reddish and dusky blotches. The young, as in all trout, are crossed by dark bands, which are, in every case, a mark of immaturity. In the Rainbow trout the head, back, and upper fins are sprinkled with round black spots, which are very variable in number. In specimens taken in the sea, this species, like most other trout in similar conditions, is bright silvery, and sometimes immaculate. This species is especially characteristic of the waters of California. It abounds in every clear brook from the Mexican line northward to Mount Shasta, and perhaps farther. No specimens have been anywhere obtained to the eastward of the Cascade Range or of the Sierra Nevada. It varies much in size, specimens from Northern California often reaching a weight of 6 pounds, while in the Rio San Luis Rey, the southernmost locality from which I have obtained trout, they seldom exceed a length of 6 inches. Although not an anadromous species, the Rainbow trout frequently moves about in the rivers, and it often enters the sea. All of the small trout which I have seen from the streams of the Coast Range belong to this species, and there is no authentic record of its occurrence outside of California.

Another California trout is the so-called Steel-head, more usually known in California as Salmon trout, a fish sufficiently like the Salmon trout of Europe, but the name Steel-head seems to me preferable because it is given to no other fish. The Steel-head, so called from the color of its head and the hardness of the bones of its skull as compared with the bones of the Quinnat salmon, is found very abundantly in the mouth of the Columbia and other rivers at the time of the salmon run. Its usual weight in the Columbia is about 12 pounds, but it occasionally reaches 20 or 25 pounds. The fishes seen in the river mouth at the time of the early salmon runs are evidently spent fishes. They are lean and lank, the flesh is pale and poor, and the bones are hard, for all of which reasons it is, or ought to be, rejected by the canners, although there is no doubt that the Steel-head, when taken at its best, may be one of the finest of all trout. It certainly reaches a larger average size than any other real trout in any country. Its scientific name is *Salmo gairdneri*, named for Dr. Gairdner, of Astoria, who first discovered the species and sent it to John Richardson. The fact that these fishes are spent in the spring would indicate a spawning time later than that of the salmon—probably midwinter—and they are probably found in the rivers at this time, because they are returning toward the sea. Steel-heads are most abundant in the Columbia, but they are not infrequently taken in the Sacramento, and several young specimens have been sent to me by Mr. Ramon E. Wilson, of the State Fish Commission, from the Eel River and the Klamath River. It is not unlikely that the most of the trout in the coastwise streams of northwestern California belong to this species.

Comparing the Steel-heads with the Rainbow trout, we find no differences, other than the former is of much larger size, and has a larger mouth, and its caudal fin is truncate instead of forked. But the tail becomes more truncate and the mouth larger with age in all species of salmon and trout. If a Rainbow trout were to reach the size of the Steel-head, it ought to acquire characters similar to those of the latter species. It is not at all unlikely that the Steel-head is simply a Rainbow trout which has descended into the sea, and which has grown larger and coarser and acquired somewhat different form and habits, on account of its food and its surroundings. If this be true, the very young Steel-heads would not be distinguishable from the young Rainbow trout, and I do not know a single structural character of any kind by which the two may be separated. In every other case there is some mark, some difference in the number of scales or bones, by which we can tell the species of trout, the one from the other; but in the case of the Steel-head there is absolutely no such difference. The Rainbow trout is a small, plump fish, found in the fresh-water streams, and having certain peculiarities of form and coloration. In every internal respect, in every bone and every part of its structure, the Steel-head and the Rainbow trout agree, and so it is one of the unsettled problems connected with the fisheries of California whether the Steel-head is a distinct kind of trout, or whether any Rainbow trout, placed in the ocean or the river mouth, and allowed to feed on the rich food which the salmon gets, would not, in time, develop into a Steel-head regardless of the form of its parents. The evidence, so far as it is in, is conflicting. There are some things which go to show that the two are distinct fishes. Other evidence would show that they are simply forms of the same thing, and a thorough study of the coastwise streams of this State is necessary before this point can be settled. If the two are the same, then the name *Salmo irideus* must drop from our lists, because the Steel-head was first introduced to science, and the name of *Salmo gairdneri* is the oldest.

The remaining trout of this coast is the species known as the Cut-throat trout, or *Salmo mykiss*. This is the longest known of the American trout, having been discovered first by Steller, who gave it the Russian name of *mykiss*, which science has preserved. It is the most widely distributed of all our trout, being found throughout Alaska, Kamtschatka, in all the streams of Washington and Oregon, in the northwestern part of this State, throughout the rivers of the Great Basin of Utah, in all the streams on both sides of the Rocky Mountains until we come to the desert lands, where the washes of sand make the streams uninhabitable to any trout, and thence extending its range southward in the mountains as far as the springs in Chihuahua, the southernmost point reached by any trout in any country. Throughout this vast area the *Salmo mykiss* is found. It is subject to very great variations according to the character of the water, according to the food which it receives, and according to various other less known circumstances. It is, however, in all this region, substantially the same fish. In some places it reaches a weight of 25 or 30 pounds. In the southernmost limit of its range it never becomes more than a fingerling, but everywhere in this whole great region every specimen retains more or less distinct traces of the same mark—a deep crimson or scarlet blotch on the half-concealed membrane between the two branches of the lower jaw—the mark which has suggested the name of Cut-throat trout. It has much smaller scales than the Rainbow trout or the Steel-head. In fact it has smaller scales than any other of the known species of trout, although much larger than the scales of any of the charrs. In a longitudinal series along the side the usual number is about 175. Excepting the red blotch and the presence of black spots somewhere, all other details of coloration are extremely variable. As we go eastward the spots tend to bunch themselves more and more on the tail, so that in eastern Colorado, on the Rio Grande and the Platte, most specimens that are taken are spotted almost entirely on the tail. In Washington and Oregon the spots are usually evenly divided over the back, and in the trout of Lake Tahoe they commonly cover the belly also. In California it has been positively found only in Lake Tahoe, in the Feather River, and in some streams of the northwestern part of the State. It will probably be found to be the common trout of Lassen and Modoc Counties, and perhaps along the east slope of the entire Sierra Nevada. The largest known specimens have been taken in Lake Tahoe and in the salt water about Puget Sound. Here it is a very common fish. As in the case of all trout entering salt water, these sea-run individuals are more silvery and less spotted than those found in the mountain streams and the lakes. The presence of salt water in all fishes destroys the black spots and markings which are found in fresh water, replacing them by a uniform silvery hue. The same effect is noticeable when trout enter alkaline lakes. Thus, the trout of Utah Lake are more silvery than those which inhabit any of the surrounding streams, the waters of Utah Lake, in the summer at least, being milky with alkali.

The remaining fish of this family to which I need refer, is the Dolly Varden trout, or charr, which is the finest of the trout-like fishes on this coast. It is found in the upper Sacramento, and thence along the line of the Cascade Range as far as Kamtschatka. It often enters the sea, where it loses its spots and becomes plain silvery gray. I have myself obtained a specimen, weighing 11 pounds, near Seattle, in Puget Sound, but in the mountain streams specimens weighing even a single pound are comparatively rare. It is true of all the trout that their size depends upon the conditions. They all grow large in the sea, and in the little mountain brooks their size corresponds to their advantages; every trout, large or small, is perfect so far as he goes. The Dolly Varden trout is scarcely different from the Eastern Brook trout, the slight difference being, on the whole, to his advantage. It is rather plumper in body than the Brook trout of the East. The red spots are found on the back as well as on the sides, and the back and upper fins do not show the dark green marblings which are characteristic of *Salvelinus fontinalis*. In food, in body, and in gaminess, the Dolly Varden, or *Salvelinus malma* (this, too, a Russian name, first given it by Steller), is not inferior to its Eastern cousin.

Everywhere on the Pacific Coast, in the clear streams of the Cascade, the Sierra Nevadas, and even the Coast Range of mountains, some species of trout abounds. This region should be the paradise of anglers. In the East, according to the words of the veteran angler, Rev. Myron W. Reed, the day of the trout is passed:

"This is the last generation of trout fishers. The children will not be able to find any. Already there are well-trodden paths by every stream in Maine, in New York, and in Michigan. I know of but one river in North America by the side of which you will find no paper collar or other evidence of civilization. It is the Nameless River. Not that trout will cease to be. They will be hatched by machinery, and raised in ponds, and fattened on chopped liver, and grow flabby and lose their spots. The trout of the restaurant will not cease to be. He is no more like the trout of the wild river than the fat and songless reedbird is like the bobolink. Gross feeding and easy pond life enervate and deprave him. The trout that the children will know only by legend is the gold-sprinkled living arrow of the white water; able to zigzag up the cataract; able to loiter in the rapids; whose dainty meat is the glancing butterfly."

OFFICE OF THE BOARD OF FISH COMMISSIONERS,
SAN FRANCISCO, March 15, 1892.

[BULLETIN NO. 5.]

To game dealers, hotel and restaurant keepers, and all persons engaged in the business of dealing in or selling ducks or English snipe:

Your attention is especially called to the following ordinance, adopted by the Board of Supervisors of the City and County of San Francisco, July 22, 1890:

ORDER No. 2,249.

PROHIBITING ANY PERSON FROM HUNTING, PURSUING, SELLING, KILLING, OR OFFERING FOR SALE, ETC., ANY MALLARD DUCK, WIDGEON, ETC., BETWEEN THE FIRST DAY OF MARCH AND THE FIRST DAY OF SEPTEMBER, OF EACH YEAR.

The People of the City and County of San Francisco do Ordain as follows:

SECTION 1. It shall be unlawful for any person, between the first day of March and the first day of September, of each year, in the City and County of San Francisco, to hunt, pursue, kill, or destroy, or to buy, sell, barter, exchange, offer or expose for sale, transport, or have in his possession, any mallard duck, widgeon, teal, redhead, pintail, gadwall, wood duck, or Jack Wilson snipe, commonly known as English snipe.

SEC. 2. Any person violating the provisions of this order shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punishable by a fine of not less than fifty dollars, nor more than five hundred dollars, or by imprisonment in the county jail for not more than six months.

JOHN A. RUSSELL, Clerk.

Approved: San Francisco, July 22, 1890.

E. B. POND,
Mayor, and ex officio President Board of Supervisors.

It is the intention of the State Board of Fish Commissioners to enforce the above ordinance by prosecuting every person who, between the first day of March and the first day of next September, shall sell, offer or expose for sale, or have in his possession, any of the ducks mentioned in the above ordinance, or any Jack, or English snipe, whether the same be held in cold storage or otherwise.

Issued by order of the Board.

RAMON E. WILSON,
Secretary.

OFFICE OF THE BOARD OF FISH COMMISSIONERS,
SAN FRANCISCO, July 12, 1892.

[BULLETIN NO. 6.]

Three specimens of trout caught in Mount Whitney Creek, on Mount Whitney, by Mr. Harvey, of Lone Pine, Inyo County, California, and by him given to Hon. George S. Mills, Fish Commissioner of Nevada, who in turn sent them to Mr. William H. Shockley, were sent to Dr. David S. Jordan, President of Leland Stanford, Junior, University, with request that he classify them. The following is what Dr. Jordan has to say of them:

> They are the famous Golden trout of Mount Whitney and the upper Kern River, which has attracted the attention of anglers for some little time, but which has not yet, so far as I know, received any adequate notice in print.
>
> The trout were first brought to my notice by Lieutenant Wheeler's geological survey, which brought me specimens in 1877. These were not in very good condition. I regarded them as of the same kind as the trout in the headwaters of the Colorado, at the same time calling attention to the remarkable distribution of species on both sides of the desert and the mountains. Later on I received other small specimens, but still in such poor condition that I could do nothing more with them. The three received were in perfect condition, and I have had a colored painting made of them. The fish is really a distinct species of trout, entirely different from any found elsewhere, either in the Rocky Mountains or Sierra Nevadas. The very small size of its scales, the lack of teeth on the hyoid bones, and the peculiar color markings, are all distinctive of this trout, which will in time receive a name of its own.
>
> It seems evident, so far as one can judge of such matter, that this trout is descended from the trout of western Colorado, which abound in the tributaries of Clear River, the Green River, and the Grand River, and in the Gunnison district. But in being separated from these trout it has undergone a considerable change, and one would think this separation must have occurred before the Sierra Nevadas were elevated. It has already been claimed by geologists that the Kern Valley, although on the California side of the Sierras, is geologically a part of the Great Basin. Its trout, at any rate, are wholly different from the Rainbow trout of California.

Issued by order of the Board.

RAMON E. WILSON,
Secretary.

DESCRIPTION OF A NEW SPECIES OF TROUT (SALMO KAMLOOPS).

FROM THE LAKES OF BRITISH COLUMBIA.

By David Starr Jordan.

Salmo Kamloops. Species nova.

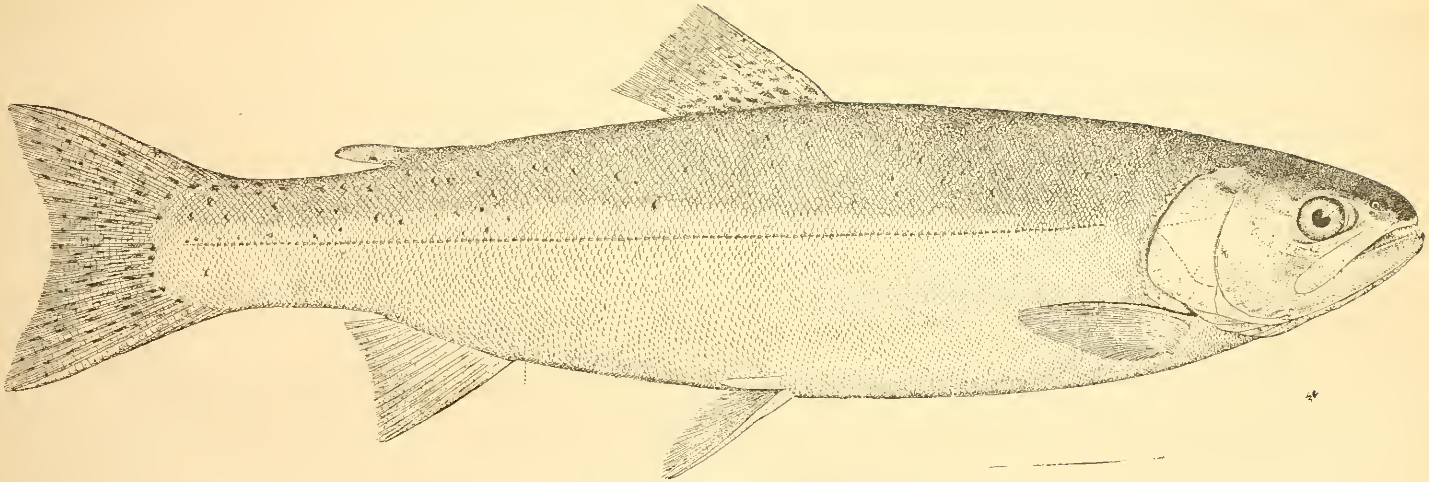
Head $4\frac{1}{2}$ in length to base of caudal; depth, $4\frac{1}{3}$; dorsal rays, 11, not counting the rudiments; anal rays, 11 in one specimen, 12 in the other, besides 3 rudiments; scales, 30–145–26 (in second specimen 135 scales); about 120 pores; length of body, largest specimen, $16\frac{1}{4}$ inches; smallest specimen, $15\frac{3}{4}$.

Body moderately elongated, somewhat compressed, the general form resembling that of a Silver salmon (*Oncorhynchus kisutch*); jaws in the typical specimens not prolonged, the maxillary extending beyond the eye, its length not quite half the head; snout slightly rounded in profile, the profile regularly ascending; eye large, about as long as snout, $4\frac{1}{2}$ times in head; teeth moderate, some of those in the outer row in each jaw moderately enlarged; teeth on tongue and vomer, as usual in *Salmo gairdneri;* opercles striate, not much produced backward; branchiostegal rays, 11 on each side; dorsal fin rather low, its longest ray slightly greater than the base of the fin, $1\frac{3}{5}$ in head; anal fin lower and smaller than usual in *Oncorhynchus*, but larger than usual in the trouts, its outline slightly concave, its longest ray greater than the base of the fin and a little more than half-head; adipose fin moderate; caudal fin rather broad, distinctly forked, its outer rays about twice inner; pectoral fins rather long, $1\frac{1}{3}$ in head; ventrals moderate, $1\frac{3}{4}$ in head; gill-rakers comparatively short and few in number, about $6+12$, or 11.

Coloration dark olive above, bright silvery below, the silvery color extending for some distance below the lateral line, where it ends abruptly; when fresh the middle of the sides in both specimens was occupied by a broad band of bright light rose-pink, covering about one third of the total depth of the fish; back above with small black spots, about the size of pin-heads, irregularly scattered, and somewhat more numerous posteriorly; a very few faint spots on upper part of head; dorsal and caudal fins rather closely covered with small black spots similar to those on the back, but more distinct; a few spots on the adipose fin, which is edged with blackish; lower fins plain; the upper border of the pectoral dusky; a vague dusky blotch on the upper middle rays of the anal; ventrals entirely plain.

The intestines had been removed, and so no account can be given of the pyloric cœca.

The existence of this fish was first known to me from conversation with Mr. A. C. Bassett, of Menlo Park, California, a very enthusiastic angler, who had taken the fish in the Kamloops Lake in British Columbia. I was unable to identify the fish from the account given by Mr. Bassett. In going for a summer outing in July, 1892, Mr. Bassett went



THE KAMLOOPS TROUT. (*Salmo Kamloops.*)

to Kamloops Lake and secured the two type specimens, which were carefully placed in alcohol and sent to me. The following statement of their habitat was furnished me by Mr. Bassett:

> These specimens were taken at the outlet of Kamloops Lake into the South Thompson; the North Thompson River flows into the upper end of the same lake. These waters connect with the Shuswap Lakes, and this fish we find in all the tributaries of the last named lakes, also in Okanagan Lake, the waters of which flow towards the Columbia (the other lakes being tributary to the Fraser River). Reliable information gives the weight of the largest speimen ever caught in Okanagan Lake as 17½ pounds. The Shuswap Indian name for this salmon is *Stit-tse*. They have been taken fifty miles below the Kamloops Lake in the Thompson River, but not in large numbers.

Mr. Bassett has since informed me that the species is found also in Kootenay Lake, and that it is locally known as Silver trout.

This seems to be a species of trout distinct from those hitherto authentically recorded from the waters of the Pacific Coast. There is not much doubt, from the account of Mr. Bassett, as well as from the appearance of the fish, that it is a "land-locked" species. Its nearest relationships seem to be with the Steel-head trout, or Salmon trout (*Salmo gairdneri*), from which it differs somewhat in coloration, and especially in the longer pectoral fin and in the form of the preopercle. It is, however, not unlikely that it is descended from *Salmo gairdneri*. This species is really intermediate between the ordinary trout and the Pacific salmon, composing the genus *Oncorhynchus*, and its characters indicate the necessity of replacing all in the genus *Salmo*.

I have given the species the name of the lake from which it was first taken. One of the two type specimens has been sent to the United States National Museum, and the other is in the museum of the Leland Stanford, Junior, University. With these two specimens was a small fish about 5 inches long, of the kind on which these salmon were feeding. This little fish was without spots, and has some 18 rays in the anal fin. Apparently it is the young of the Quinnat salmon; certainly it is not the young of the species in question.

PALO ALTO, September 12, 1892.

DESCRIPTION OF THE GOLDEN TROUT OF KERN RIVER.

SALMON MYKISS AGUA BONITA.

By David Starr Jordan.

I have lately received from Mr. W. H. Shockley, of San Francisco, three specimens, each about 7 inches in length, of the Golden trout of Kern River. These specimens were taken by Mr. Harvey, of Lone Pine, California, in a stream called by him Whitney Creek, on the west side of the Sierra Nevada, near Mount Whitney. The specimens were sent in ice to Mr. George T. Mills, Fish Commissioner of the State of Nevada, who forwarded them to Mr. Shockley. The following is a detailed description:

Salmo Mykiss Agua Bonita. New sub-species.

Head, $3\frac{3}{4}$ in length; depth, $4\frac{1}{3}$. D. 2, 12; A. 1, 10. Scales, 130 to 200 rows; 121 to 124 pores. Length, 7 inches.

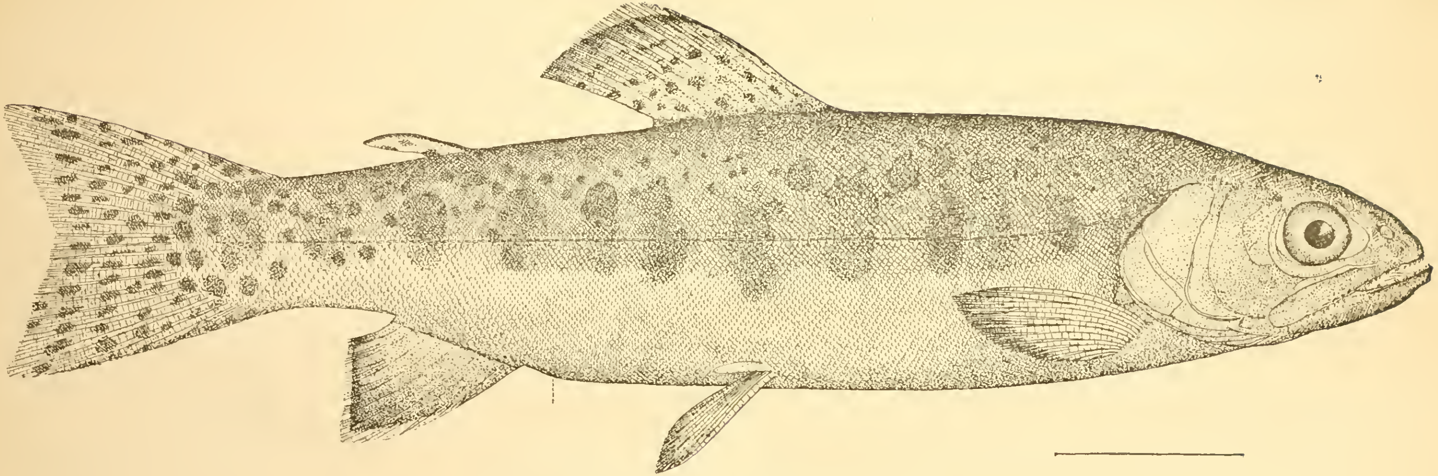
Body formed about the same as usual in *Salmo mykiss* and its varieties. Head rather long, bluntish at tip; mouth moderate, the maxillary extending a little beyond the eye, $1\frac{4}{5}$ in head. Hyoid teeth not evident; opercle moderate. Its greatest length $4\frac{1}{3}$ in head; its posterior margin moderately convex. Eye, $4\frac{2}{3}$ in head; snout, $4\frac{1}{2}$; gill-rakers not very short, x+11 or 12 in number.

Scales extremely small, smaller than in any other species of *Salmo*. Fins moderate; the anal high, the caudal moderately emarginate; pectoral, $1\frac{4}{7}$ in head; ventral, 2; caudal, $1\frac{2}{5}$.

Olive above; sides and belly light golden; about twelve dark cross-bars on middle of sides; these the usual parr-marks; middle of sides along lateral line with a deep scarlet lateral stripe, broadest under the dorsal, where it is about as wide as eye; thence narrowing to either end, and not reaching either head or caudal; middle line of belly with a broad scarlet band, extending from chin to anal fin, equally bright all the way; a fainter shade along lower side from anal fin to tip of caudal; no crimson dash at throat between branches of lower jaw; the whole region uniform bright orange; opercle largely orange.

Dark spots chiefly posterior, as in *spilurus* and *pleuriticus*, large and well marked, some as large as pupil on tail and posterior part of body; smaller and well marked on dorsal; a few small ones scattered along forward to the head in two specimens; none on body before adipose fin in the other.

Upper anterior angle of dorsal abruptly yellowish white; this color edged by a dark oblique streak, made by coalescent spots; the rest of the fin light olive with four or five rows of small black spots; pectorals light orange; ventrals deep orange, with a faint blackish tip; the anterior edge of the fin conspicuously and abruptly whitish, as in *Salvelinus fontinalis;* anal dusky orange, the tips of the last rays blackish, the outer anterior corner abruptly white, the white stripe wider than the pupil, and separated from the color of the fin by a dusky shade.



The Golden Trout. (*Salmo mykiss agua bonita.*)

Caudal olive, tinged with orange on its lower edge, and profusely spotted with black. Inside of mouth pink; of gill cavity light orange.

Of the three typical specimens, two have been sent to the United States National Museum, and one remains in the museum of the Leland Stanford, Junior, University.

This trout is evidently an off-shoot or descendant of the widely-distributed Cut-throat trout, or *Salmo mykiss*, which is found in all the rivers suitable for trout between the Sierra Nevada and the Rocky Mountains. It, however, differs from any known specimens of any of the many varieties of *Salmo mykiss* in its pattern of coloration and the absence of the deep red patch between the branches of the lower jaw, from which *Salmo mykiss* receives its common name—Cut-throat trout—and in the small size of its scales, which are more numerous than in any of the forms of *Salmo mykiss.* Matters of less importance, which are, however, comparatively distinct, are the presence of white and black edges to the fins, and in the absence of teeth on the hyoid bone. The name *Agua bonita*, suggested for the species, is that of the falls in Volcano Creek.

The earliest record of this trout, is that of Jordan and Henshaw in Appendix NN of the annual report of the Chief of Engineers for 1878, p. 195.

The specimen collected by Mr. H. W. Henshaw, in 1875, from the South Fork of the Kern River, and No. 17,107 in the National Museum collection, is here referred to, *Salmo pleuriticus*, Cope. With this reference is the remark, that "the extension of its range west of the Sierra Nevada is rather unexpected. The prevalent theory that most of the species of trout have a narrow local range is hardly supported by a study of our western forms." This trout, Mr. Henshaw says, was "abundant in the South Fork of the Kern River, beyond which statement nothing can be said of its distribution on the western coast, or of its abundance as compared with *S. irideus*, the distinctness of the forms not having been recognized at the time of collection."

On page 195 of the same paper is a reference by Mr. Henshaw to the "Golden trout," which apparently belongs to the species here described, although Mr. Henshaw identifies his specimens taken from near Mount Whitney with the *Salmo irideus.* Mr. Henshaw says:

> This is the common Brook trout of the small mountain streams of the Pacific Slope, and up to an altitude of 9,000 feet it is the rare exception to find a suitable stream that is not well stocked with it. Upon many of them, as the tributaries of the South Fork of the Kern River, these trout are found in very great abundance, each pool and rapid numbering its finny denizens by the score. They may be taken in any sort of weather, at any hour of the day, by almost any kind of bait. During the heat of the day they frequent almost entirely the deeper pools, lying under overshadowing rocks or in the shade of some convenient log; in early morning or late afternoon they come out and run more into the shallows and rapids, under which circumstances they bite best and furnish the finest sport. Like the average Brook trout, the species rarely attains any considerable size, ranging from 4 to 8 or more inches in length. Their colors are usually very bright, and for beauty this species takes rank among the foremost of its kind, and has been well called the "Golden trout." In this respect, however, it is subject to the usual variations obtaining in the family, the change of color not only accompanying a difference in locality, but being plainly discernible in individuals taken in different parts of the same stream not far distant. In fact, as a specific character, color in this family seems to be at its lowest value. The character of the bottom and water itself has much to do with this, and I remember to have fished in a small rivulet on one of the sub-alpine meadows not far from Mount Whitney, whose sluggish waters flowed over a bottom of dark mud, in which the color of the trout simulated very closely its hue; they had lost nearly all the flashing iridescent tints characterizing the same species caught but a few hours before in another stream, and had become dull and somber-hued. Accompanying this change of color was a correspondingly noticeable difference in habits and motions, and

the several dozen trout caught that evening for supper were taken out with the hook with the display of very little more gaminess than would be noticed in so many Horned Pout. On the contrary, in the clear, rapid current of the mountain stream, a flash of sunlight is scarcely quicker than the gleam of gold and silver seen for a single instant as the whirling waters are cut by one of these trout, as he makes a rush from his lurking place for some chance morsel which is being borne past him. The western trout are rarely as shy as their relatives of Eastern waters, and because of their numbers and the consequent scarcity of food, are apt to be less fastidious; yet even when most abundant, due caution must be used if one would be successful, and not every one can catch trout, even in the West. With the proper care in concealing one's self, a pool may be almost decimated ere the alarm will be taken, and I have seen fifteen fair-sized trout taken from a single small pool in quick succession.

During the present year other specimens have been sent to the museum of the Leland Stanford, Junior, University, but in such very bad condition that nothing could be made of them, except that they were evidently small scaled trout of the *mykiss* type, and nearest to the sub-species *pleuriticus* of the Colorado River, and not in any way related to the Rainbow trout, which inhabits most of the streams of the basin of California.

In a pamphlet entitled "Whitney Photo-Campers," written by Mr. W. E. Houghton, of Bakersfield, California, and bearing the following title: "Whitney Photo-Campers, Bakersfield to Mt. Whitney and Return, July 30 to August 23, 1889: An Abstract of General Results, with some Details of the Beauties and Marvels of Kern River," I find the following references to the Golden trout, and the streams in which it occurs:

Camp Beautiful was made that day on Whitney Creek, near the Natural Bridges, at 2 P. M. The whole current of Whitney Creek foams under those bridges of lava. It is from here, and for only a distance of three hundred yards in length, namely, from Agua Bonita Falls to the Chute, that the only Golden trout in the United States can be caught. The deeper the pool the darker the fish in color, but all, as drawn from the water, have a genuine golden sheen. Whoever makes the journey below these falls deserves a prize, for it is a most difficult undertaking; but while he will be fully repaid with one Golden trout, a loaded basket will be his reward.

This whole country is distinctly volcanic. At the Divide there is a small mountain, whose surface is as red as ordinary brick. From this Red Mountain—as locally named—a stream of lava at some time flowed directly in the course of Whitney Creek as far as Kern River. At different points the trail passes over this irregular bed, while there are large piles of it on either side. In places the stream and the elements have washed the earth away, leaving perpendicular masses of lava, just as when it was in a molten state. Occasionally there will be a cave. Natural Bridge Creek forms from seven springs, all within a radius of one hundred yards, and not more than two hundred yards above the bridges. At the point where the waters all join just above the bridges, they form a good-sized trout stream, which precipitates itself over the rocks and down its steep bed, a mass of foam until it reaches Whitney Creek. One bridge is about fifteen feet wide, the other at least thirty. From the surface of the water, is on the upper side about ten and on the lower side forty feet. In every direction from the bridges are views of grandeur and beauty. Looking east is a beautiful little meadow with springs of water flowing into it from almost every direction. To the left, almost touching the trail, one spring sends a volume of water out of the side of a bare mountain, which equals the flow of the largest artesian well in the valley. To the south rises a timbered slope covered with pines, manzanitas, and cedars. Northward is the stream of lava, just across Whitney Creek, and back of it a perpendicular cliff towering at least a thousand feet above the spectator. But the grandest view of all is toward the west. Whitney Creek takes a leap into space. It must be at least 2,000 feet above Kern River, which the creek rushes down to meet in less than a mile. One looks down and down to fathom the end of the headlong career, to see boiling foam with occasional lines of soft, hazy blue between cliffs of enormous proportions. And at the end, across the cañon of Kern River, there rises a snow-capped giant 14,000 feet in height, which bars the rushing waters and baffles the vision. Besides numerous cascades, there are in this short distance three waterfalls, the largest perhaps 125 feet in height.

A graphic story of Golden trout is told by the Captain of the Pilgrims: "You can only get below this fall at one point, and that by an extremely hazardous route, only possible by aid of the firmly-rooted and stout bushes. Down this cliff I went with many a choky feeling, for if a bush was to give way, then good-bye all. Once at the bottom, right amid the spray of the falls, I lost all interest in the scenery and bother about brush, and fell to hook and line as quickly as possible. Down in the beautiful deep pool below me in an instant I hooked a ten-inch Golden trout, to be followed by another and another, and as many as I wanted, in rapid succession. The stream of ages has

> worn into the lava mountain, until away above my head it was a huge overhanging cliff, threatening in appearance to fall at any time, and bury me mountains deep. Once out from under, I drew a long breath and reasoned. Certainly that cavern and cliff has stood just as it is for 3,000 years, anyhow; it ought reasonably to last a few days longer; and besides, those dearly beloved Golden trout. So back under the beetling precipice again; back to the sport I had come so far to seek. The waters roared, the spray ascended, the mighty rocks continued their rest of ages, and the golden beauties rose with all the fervor of the tallest kind of true love to the cast of my glittering fly."
>
> As far up the cliffs as the spray can reach the rocks are mantled with lichens, ferns, flowers, shrubs, beautiful grasses and mosses, and in the niches, fashioned by water in perfect regularity and symmetry, vegetable growth attains rare luxuriance; while above the reach of the water, the rocky battlements have the barrenness of desolation. The lava is porous and light, but tough and enduring, and with its different strata or layers, presents a bewildering variety of colors. The broken debris at the mountain's feet is tenanted by a world of ground-hogs, whose piercing whistles are ever-sounding notes of alarm and orders for prompt disappearance.

In a recent letter from Mr. Houghton, to whom I am indebted for a copy of the above-named pamphlet, he writes:

> In the first place, "Whitney Creek" is not the proper name of the stream in which they are caught, although it is almost universally so called. The proper name is undoubtedly "Volcano Creek," so called because it runs through a bed of lava and lava formation for about ten miles from its confluence with Kern River. "Whitney Creek" proper heads in a little lake directly at the base of "New Mount Whitney," at the point where Professor Langley had his camp when making atmospherical experiments, and flows into Kern River twelve or fifteen miles north of the mouth of Volcano Creek. The latter creek does not receive any of the water shed off either old or new Mount Whitney, consequently I claim that it has no right to the name of Whitney Creek.
>
> As the book states, the Golden trout are only to be found between Agua Bonita Falls and the Chute.
>
> The first time I was there was in 1879. At that time the meat of every fish caught was a deep golden yellow. I was again there in 1887, and noticed that we occasionally caught one with white meat. In 1889 more than ——? of our catch were of white meat. This demonstrates very plainly that they are crossing with trout from above Agua Bonita Falls, which are the ordinary species of Brook trout. Fish cannot get up the Chute from Kern River, nor can they get up Agua Bonita Falls.
>
> Now, from the very peculiar form of the fish, I am more than inclined to think they are an entirely different species from any on the coast. You will observe this in the direct rise of the meat from the head to the back, giving them an almost hump-backed appearance; the same spread on the sides is something unusual. I have never seen any other trout with this peculiarity.

The question of the relation of this trout to others in Kern River must be settled by further investigations, as also the question whether the *Salmo Agua Bonita* itself is confined to the space in Volcano Creek between the two waterfalls mentioned, or whether in that part of the stream is found a variety different from the ordinary form.

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